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ABSTRACT

A construct of psychoneurological efficiency provides the guiding framework for developing early identification procedures and compensatory training for Head Start children whose inefficient information processing skills interfere with their cognitive development. Psychoneurological efficiency is the ability to process information through the body awareness and control, visual-perceptual-motor, and language modalities. Interlocking screening tests suitable for administration by the Head Start physician and teacher, have been developed by selecting objective items which predict academic achievement and relate to indices of neurological involvement. Norms are provided for four and one-half to seven and one-half year old children in both the disadvantaged and general populations. The construct of psychoneurological efficiency was investigated by examining the interaction of measures of various psychoneurological inefficiencies with cultural deprivation, neurological improvement, IQ, and academic achievement. (JM)

DEVELOPMENT OF PSYCHONEUROLOGICALLY-ORIENTED SCREENING TESTS AND CURRICULUM FOR THE DISADVANTAGED PRESCHOOL CHILD

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
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ABSTRACT

A construct of psychoneurological efficiency provides the guiding framework for developing early identification procedures and compensatory training for Head Start children whose inefficient information processing skills interfere with their cognitive development and, hence, their ability to capitalize on educational opportunities. Psychoneurological efficiency is conceptualized as the ability to process information through the body awareness and control, visual-perceptual-motor and language modalities.

Interlocking screening tests of psychoneurological efficiency, suitable for administration by the Head Start physician and teacher, have been developed by selecting objective items which predict academic achievement and relate to indices of neurological involvement. Norms are provided for 4 1/2 to 7 1/2 year old children in both the disadvantaged and general populations. The construct of psychoneurological efficiency was investigated by examining the interaction of measures of various psychoneurological inefficiencies with cultural deprivation, neurological involvement, IQ, and academic achievement.

A preliminary curriculum guide has been developed for the psychoneurologically inefficient child. Using a developmental and process-oriented approach, the teacher aims to assist the child to be a more efficient processor of information by helping him organize his behavior in the physical-interpersonal environment, and use the language, visual-perceptual-motor and body awareness and control modalities effectively to learn new skills and concepts.

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PROBLEM

The prevalence of school failure in disadvantaged children has been well documented and several pre-school programs have been developed to provide early compensation so that the chance of academic failure is reduced. At a recent conference, Eisenberg (1968) summarized the conclusions of many workers that the causes of school failure in disadvantaged children are multidimensional and interacting, and fall into two categories: biological and sociological. It is widely known that sociological factors such as understimulating or poorly organized environments are associated with inadequate cognitive development and diminished motivation for academic learning. However, while it is recognized that the inferior nutrition and medical care of disadvantaged children results in a higher incidence of disease and fatigue, little attention has been paid to the role that biological (neurological) factors might play in the lack of cognitive development itself.

From a different field of education, there is an increasing body of literature which relates school learning disabilities to inefficient sensory-motor, visual-perceptual-motor and language information processing skills. In a substantial number of these children, there is a high incidence or suspicion of neurological damage or dysfunction. Since disadvantaged children are often subject to the kind of limiting medical and nutritional care which results in neurological complications (whether mild or severe), it seems reasonable to assume that biological (neurological) as well as sociological factors may adversely affect the above-mentioned information processing skills, the cognitive development dependent on them and, subsequently, school achievement.

In order to insure a comprehensive approach to compensation of the disadvantaged child, it would seem important to be aware of 1) medical factors of health and bodily efficiency, 2) psychoneurological intactness of sensory-motor, visual-perceptual-motor and speech and language skills, and 3) motives, attitudes and cognitive sets. Head Start programs have made large gains in working with the whole child through emphasizing medical factors on one hand and motivational factors on the other. However, we feel that an important segment has been left out — one that bridges the work of medicine and education by providing a way of evaluating information processing skills through the functional efficiency of the peripheral and central nervous systems, and devising curriculum that incorporates understanding of the relationship of these information processing skills to cognitive development and academic efficiency. It is the thesis of this research that this dimension is worth exploring and integrating into already stimulating compensation programs for the preschool disadvantaged child.

RELATED RESEARCH

PSYCHONEUROLOGICAL INEFFICIENCY AND THE DISADVANTAGED

The prevalence of school failure in disadvantaged children has been well documented (summarized in Bloom, Davis and Hess; Hechinger; Hess and Bear; Hellmuth - 1967). A host of experiential variables such as limited or disorganized experience, inadequate learning and behavior models, and negative experiences with learning and teachers have been implicated (Clark, Reissman, Deutsch - 1964, Edwards). Because of these experiential factors, not only may the child's attitudes and sets for learning be faulty, but the very skills by which he processes information may be under-developed. In particular, language listening and language expression skills have been found lacking (Clark and Richards; Deutsch - 1964; Bereiter and Englemann). Basic sensory-motor and visual-perceptual-motor skills also suffer (Deutsch - 1968). However, only three articles out of several hundred in a recent summary of literature on the disadvantaged (Bloom, Davis and Hess) touch on the evaluation or training of non-verbal or visual-perceptual-motor processes. However, the results suggest that this area is also deficient in the disadvantaged.

Although not yet sufficiently taken into account in programming for the disadvantaged child, there is another set of limiting factors which has shown to be operating against the culturally deprived. Reporting data from the Collaborative Study*, Clifford (1965) indicates that the incidence of neurological problems is higher in the lower socio-economic population. Inadequate medical care, pre-and post-natally, has been related to increased pre-maturity, stressed births and resultant neurological difficulty. It can therefore be assumed that there is a much higher incidence of neurological dysfunction (minimal and severe) among disadvantaged children than in the general population.

The knowledge of the relationship between neurological damage and the intactness of basic sensory-integration-motor systems of the body dates back to antiquity. Recently, evidence has been accumulated to suggest a continuum of neurological problems from cerebral palsy and other forms of brain damage to more minimal deficits — the latter have been labelled minimal cerebral (or brain) dysfunction (Denhoff & Robinault, Clements, Mahler, Pasamanick and Knobloch). The effects of both severe and minimal neurological involvement include characteristic difficulties in sensory-motor, visual-motor and language skills and in behavioral control (Eisenberg, 1957). These difficulties seriously affect the ability of children to process information and often results in learning disabilities (Hellmuth-1965, 1966, deHirsch, Barsch, Johnson and Myklebust). Consequently, academic performance in school can be considered to be extremely dependent on these basic information processing skills. Slingerland (1966) summarized authoritative estimates of prevalence figures for "intelligent" children who have disabilities in these skills (severe enough to disrupt academic functioning) as from 7-15 percent. When considering the total population of children entering school, not just the "intelligent" as above, Barsch (1967) indicates that only 50 percent are ready to absorb the "model curriculum": that is, a regular school curriculum without modification. Even if one excludes children with severe physical disabilities or emotional disturbance, there remains a large percentage of children who show inefficient information processing skills and need some form of curriculum modification.

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*Collaborative Study of Cerebral Palsy, Mental Retardation and other Neurologic and Sensory Disorders of Infancy and Childhood. National Institute of Neurological Diseases and Blindness, National Institutes of Health, Bethesda, Maryland.

This situation is felt to be particularly acute for many culturally deprived children because of higher incidence of neurological complications in the disadvantaged. In many cases, the effect may be interactive and additive. Wortis and Freedman (1965) found that prematurely born children, who are known to have a higher incidence of neurological deviation, are more vulnerable to the effects of an impoverished background than those born at term. Whatever the factors, culturally deprived children are less likely than other children to be efficient in receiving and discriminating sensory information, in processing it, and in organizing a motor response that is efficient and appropriate to the situation (termed "psychoneurologically efficient" by the authors of this paper). Although there are no prevalence figures, if from 15 to nearly 50 percent of all children entering school are unable to handle a regular school curriculum because of information processing difficulties, a larger percentage of culturally deprived children can be assumed to be affected.

The authors of this proposal have adapted a psycholinguistically-based model (Osgood) to describe the effectiveness of the organism in the intake (decoding), integration (association), and output (encoding) skills of information processing. This model has had some use in the field of special education. The Illinois Test of Psycholinguistic Abilities (Kirk and McCarthy) represents a diagnostic evaluation based on this model and certain programs for the perceptually handicapped, language impaired, or specific learning disability child have also utilized it to some degree (Messing, Frostig and Horne, Johnson and Myklebust). Recently Gallagher (1968) discussed a five step sequence of information processing which includes orientation (focus of attention), intake of information, integration (association, generalization, memory), output of information, and feedback of results. The authors see this intake-integration-output model cutting across several modalities, including the visual-perceptual-motor, language, and body awareness and control (Hainsworth and Siqueland).

The ability of a child to utilize and process information appears to the authors (and to Deutsch-1968) to depend on the efficiency of the peripheral and central nervous systems; this efficiency, in turn, reflects the intactness of the neurological equipment interacting with sufficient environmental stimulation, and is herein called psychoneurological efficiency. Myklebust and Boshes (1960), as well as Luria (1961), have also found it a useful concept. Psychoneurological inefficiency does not necessarily presuppose brain damage or even minimal brain dysfunction as these terms are currently understood. It represents any breakdown in the way information is processed — whether this be primarily from lack of training or from a breakdown in the basic neurological equipment or both. While originating from and conceptually linked to the broad area of minimal cerebral dysfunction and neurological impairment, psychoneurological efficiency is a more comprehensive term since it does not presuppose any one etiology. It is felt to have theoretical value as a mediating concept between biological-sociological factors of etiology on one hand and cognitive development and academic learning on the other. It is the opinion of the authors that the disadvantaged child and the child with a learning disability often manifest similar psychoneurological inefficiencies in information processing skills and resultant cognitive and academic deficiencies.

SCREENING TESTS OF PSYCHONEUROLOGICAL INEFFICIENCY

Few research investigators have been concerned with the early identification of those children who may later encounter difficulty on the basis of body awareness and control (sensory-motor), visual-perceptual-motor and language skill inefficiencies. The need for diagnostic tests for the disadvantaged pre-schooler that relate to compensatory curriculum has been discussed by Deutsch (1968). The need for such procedures and associated curriculum was also voiced by a number of school districts and university settings at the 1968 conference of the Association for

Children with Learning Disabilities. Recent research from several professional areas (typified by Haring and Ridgway, deHirsch, and Ozer), indicates increasing interest in such early identification. The inefficiency of attempting to identify large numbers of children with the procedures compiled by Haring and Ridgway (1967) is obvious, since several hours of testing by experienced examiners are required for each child. The interesting preliminary language-based work of deHirsch (1966) attempts to predict reading failure related to language deficits. From a medical orientation, Ozer (1966) has devised a neurological evaluation for school aged children. Personal communication with Tizard and Bax in England, indicates that they, too, are experimenting with early screening procedures. However, to our knowledge, there are no early identification tests that are efficient in spotting children with multidimensional problems and are adequately standardized.

Dr. Eric Denhoff and the staff of Meeting Street School and an affiliated private school have been serving as a major diagnostic and medical-educational remedial center for school learning disorders in the New England area (Denhoff and Novack). The impetus for this work has been the large number of children who are found to have psychoneurological inefficiency as the prime basis for their learning disability. Moreover, by the age of eight to twelve, these childrens' problems are often compounded by adverse emotional reactions and maladaptive learning habits. These concerns emphasized the need for early identification procedures.

Preliminary work on the present screening tests for psychoneurological efficiency, referred to as the Meeting Street School Screening Test (MSSST), drew on tests which members of the pediatric neurological team (neurologist, psychologist, occupational therapist, physical therapist, speech and language therapist) felt were diagnostic of childrens' learning disabilities (Denhoff and Meeting Street School; Denhoff, Siqueland, Komich and Hainsworth). During the year of this research, a form of the MSSST suitable for use by school personnel has been published (Hainsworth and Siqueland).

The study of the validity of instruments purporting to predict learning disabilities is a complex problem. Many recent articles and symposiums have been addressed to the confusion resulting from conflicting terminologies and assumptions of etiology (Clements, Michael-Smith and Morgenstern). The authors assume that there are multiple causes of learning disabilities and, therefore, that there is no one criterion measure that can establish validity. Rather it is important to deal with the complexity of factors, examining each singly in the hopes of eventually clarifying the way they interact. Among such criterion factors are: academic success, measures of neurological dysfunction (minimal or otherwise), and cultural deprivation.

The relationship between MSSST items and academic success has been investigated (Hainsworth and Siqueland). While the prediction of school success has long been based almost solely upon intelligence test scores, the results of our studies suggest that, while IQ scores do relate to later school success, they are not the only or even the most efficient predictors. The correlation between MSSST and achievement scores range from .53 to .82 as compared with .42 to .69 between group IQ scores and achievement (Hainsworth and Siqueland). This supports the notion that proficiency in "lower level" skills involving the organization of input and efficiency of output is of more consequence for success in the primary grades than ability in "higher level" abstract reasoning processes. A combination of IQ and another factor representing these "lower level" skills, such as tapped by the MSSST, results in superior predictions than either indicator used alone.

Since the relationship between MSSST and IQ is such a crucial one, a conscious effort was made in constructing screening tests of psychoneurological efficiency to avoid items loaded with "general intelligence". It is our hypothesis that what the MSSST measures (psychoneurological efficiency) and what IQ tests measure are relatively independent constructs which, used jointly, provide a better understanding and prediction of school efficiency for a given child than either alone. In fact, factor analytic data based on the original 36 item MSSST suggested that IQ and "neurological efficiency" were orthogonal to each other, with school achievement sub-tests scattering in between (Denhoff and Meeting Street School).

The second criterion measure, whose relationship to the MSSST warrants investigation, is that of neurological involvement. There are two practical ways of identifying a group of children with this diagnostic label. The first is through developmental neurological evaluation, such as provided by the Meeting Street School diagnostic team. In a preliminary analysis of 25 children enrolled at Meeting Street School who have a medical diagnosis of neurological impairment, scores on an early version of the MSSST were significantly different from scores of children of comparable age, sex, and socio-economic level in the public school setting ($t=8.7$, $p \quad .01$). The second way of identifying such a group of children is through analysis of birth history and developmental information, such as available through the above-mentioned Collaborative Study research program.

Finally, the relationship of a test such as the MSSST to cultural deprivation can be hypothesized from what is known about the relationship of the MSSST and cultural deprivation independently to such factors as school achievement and intelligence. Quite likely the disadvantaged child will score lower on the MSSST, intelligence tests, and school achievement tests than the middle class child. Specifically, we expect that the disadvantaged child will have difficulty in receptive language (Clark and Richards) and expressive language (Deutsch–1964). However, it is only by comparing different groups of disadvantaged children against standard norms for the population on a wide range of information processing skills (from peripheral sensory integration and motor coordination to more central integrative processes) that the nature of the differences between disadvantaged and middle class groups will be clarified. The MSSST will provide information on the various sensory, perceptual and motor precursors to cognitive development, thereby leading to a better understanding of individual disadvantaged children and their needs. Finally, the relationship of the MSSST to IQ scores may help clarify how various aspects of cognitive development are affected by psychoneurological efficiency. This information will help refine the use of changes in IQ scores over time as a basis of evaluating progress in programs of compensation.

PSYCHONEUROLOGICALLY-ORIENTED CURRICULUM

The area of compensatory education for the disadvantaged is new and many workers are searching for efficient models and concepts to guide curriculum development. Many different and overlapping programs have been developed and each is predicated on a theory of what the disadvantaged child is lacking and what he needs to be able to function successfully in school: the range of stimuli and experiences of the middle class child (programs based on traditional pre-school procedures); an organized environment in which perceptual and conceptual development seen in the middle class child may proceed (Caldwell, Deutsch, Gray and Klaus); Montessori techniques for sequentially advancing sensori-motor skills into conceptual development (Kohlberg); techniques adapted from education for the deaf in which cognition is stimulated through programmed language training (Bereiter and Engelmann); and reinforcement techniques (Baer and Wolf, Gray and Klaus). Some programs aim at wide changes in the motivational, social, cognitive and knowledge areas (Caldwell and Richmond, Deutsch - 1964, Gray and Klaus) others focus on providing more specific training relevant to the cognitive underpinnings of academic success (Kohlberg, Bereiter and Engelmann). Programs differ in the emphasis placed on how experiences are presented versus what experiences are deemed necessary.

The present curriculum is based on the model of information processing as a key to the cognitive development necessary for later academic success, and on methods adapted from the education of the children with learning disabilities or minimal cerebral dysfunction. It is hypothesized that a host of medical-neurological, as well as experiential or environmental, factors produce psychoneurological inefficiencies in the way culturally deprived children process information in the visual-perceptual-motor, language, and body awareness and control modalities. The program is thus more similar to those proposing specific training than broad social influence. This psychoneurologically-oriented curriculum is a composite of Meeting Street School's own experience in adapting education for the neurologically handicapped to the child with minimal cerebral dysfunction, selected aspects of previously proposed Head Start programs, and certain elements of education for the child with a specific learning disability. The relevance of each of these areas is discussed below.

Programs for the Disadvantaged:

Many investigators are now convinced that merely providing a stimulating and culturally-rich environment cannot make up for past deficits or is inappropriate to the developmental level and interest of the disadvantaged or cannot be taught fast enough to overcome deficits in time. The development of cooperation, intrinsic motivation, self-expression and creativity skills are often mentioned as goals of curriculum for the disadvantaged. However, to a large extent, these latter skills may be assumed to be by-products of the classroom approach rather than directly teachable (Caldwell). In terms of what is taught, there is considerable agreement that cognitive development is crucial to the disadvantaged child. Caldwell (1968) describes the sensory-perceptual-cognitive category as any sensori-motor or conceptual procedure necessary for information processing--including listening, watching (attending), classifying, evaluating, coordination and relating, remembering, conceptualizing, solving problems and forming learning sets, as well as certain receptor-effector integration skills involved in talking, drawing or writing. It seems generally agreed that these skills are central to the disadvantaged child's failure or success in handling the symbolic content of the elementary school program.

However, there is considerable variance in opinion as to the manner in which cognition should be developed. Some would rely on sensory stimulation (Hunt) or on developing sensori-motor operations (Kohlberg). Others (Gray and Klaus) seem to concentrate on molding the environment (how things are arranged for, or people react to, the child). At the other extreme, Bereiter and Engelmann (1966) suggest that the cognitive skills necessary for successful participation in school be imposed as directly and as efficiently as possible through specialized language and concept training. It is the feeling of the authors that, to some extent, these different approaches are justified when children of differing ages and skills are being considered. Thus sensori-motor training may be more applicable to younger or more seriously delayed children and specific cognitive training through a formal language approach to psychoneurologically intact older children.

The information processing model discussed above (Osgood, Gallagher, Hainsworth and Siqueland) seems to offer a useful way of looking at cognitive development. It shows how the cognitive or integrative processes like comparing, sorting, categorizing and response selecting are dependent on efficient intake and output skills; all together, they make for successful information processing. The authors see this intake-integration-output model cutting across several modalities — including the visual-perceptual-motor, language, and body awareness and control. Head Start programs have concentrated mainly on cognitive development through language training or stimulation and have largely ignored the visual-perceptual-motor and body awareness and control factors. Those few programs which have stressed sensori-motor development seem to neglect the language dimension. Further, an information processing model of the type proposed in this research can cope with a wide range of behavioral organization and sensory-perceptual-cognitive skills, from peripheral sensory-motor systems to more central integrative processes. Previous compensatory programs have stressed those aspects of cognitive development which apparently can be influenced by increased motivation for learning and have paid considerably less attention to aspects of cognitive development affected by efficient use of neurological equipment. Finally, greater contributions to Head Start programming might result if physicians, physical therapists, occupational therapists, and speech and language therapists could add their knowledge to the problem of curriculum development for the disadvantaged.

Programs for the Child with a Learning Disability:

Theory and practice in the area of education for children with learning disabilities or minimal cerebral dysfunction has relevance to the education of the disadvantaged. Although most of the work in the area of learning disabilities has been concentrated at the upper elementary school level, the emphasis is shifting to early identification before the occurrence of failure in the school situation and to development of specialized curriculum methods and materials for intervention in the pre-school and early elementary grades. It is interesting to note that educators of the disadvantaged (Bloom, Davis and Hess) and educators of the specific learning disability child (deHirsch) both propose an extended transition period covering the pre-school through the early elementary years in which compensatory skill development (rather than academic proficiency) can be developed.

Remedial education for children with learning disabilities has stemmed from two major sources. Orton (1937) pioneered in the area of language disability, and the work has been continued by Gillingham (1940), Childs (1960), Johnson and Myklebust (1967), and deHirsch (1966). Strauss and Lehtinen (1947) pioneered the other trend, one based on a concept of brain damage and resultant perceptual-motor disability. Kephart (1960), Cruikshank (1961), Frostig and Horne (1964), and Barsch (1967) have greatly expanded knowledge of the perceptual-motor and related body awareness and control areas. The recent work of these and other workers has adapted the methods used with brain damaged children to a wider and more minimally affected group — described by the terms minimal cerebral or brain dysfunction, perceptually handicapped, learning disability, etc. (summarized by Clements, Hellmuth - 1965, 1966).

Except for certain specialized programs, the major thrust of education for children with learning disabilities has concentrated on the upper elementary and junior high school levels and has utilized academically-oriented material. Two of the newer trends include innovative administrative techniques, and a rethinking of the relationship of diagnosis to remediation. The first involves extending the program to cover children with minimal as well as severe deficits, by providing a range of educational opportunities including individual tutoring, diagnostic classrooms, transition classes for kindergarten and first grade children with minimal problems, new groupings in the ungraded primary, resource rooms — as well as the traditional special class.

The second trend views diagnosis and treatment as an interactive unit. Individual diagnosis is seen as an ongoing process involving increasing differentiation of strengths and weaknesses through use of test materials and through evaluation of the individual's response to various intervention techniques (Bannatyne, Beery). This demands that diagnosis and treatment be considered a fluid process, guided by one theoretical framework. In this spirit, the present research aims at developing interlocking screening tests and curriculum, both stemming from the concept of the psychoneurological efficiency of information processing skills. Moreover, this second trend demands that intervention techniques have a diagnostic orientation. Bateman (1967) has suggested the term task analysis for the kind of teaching that breaks down any task presented to a child into its component parts. This concept has been adapted by the present authors to show how any task depends on certain levels of skill development in various information processing modalities. Knowledge of the sequence of development of these skills and sequences of activities that can be used to develop them provide the cornerstone of curriculum for the psychoneurologically inefficient child.

Historically, the emphasis in the area of learning disabilities is shifting from the child who has already failed school to preventing such failure in others through early identification and intervention. Concommitantly, the emphasis has changed from remediation of academic deficiencies to development of the underlying skills crucial to academic success. Outside of Meeting Street School, few investigators have worked with children below school age and hence many programs are of such recent origin that they have not yet been published. The programs already beginning to concentrate on the pre-school or kindergarten child include Karrenbauer (1968), Frostig and Horne (1964) in the visual-perceptual-motor area; Cecci (1968), Messing (1968) in the language area; and Barsch (1967), Kephart (1960) in the gross motor or body awareness and control area. All of these approaches utilize some form of intake-integration-output model of information processing, but generally concentrate on one area and do not involve cross-modality training to any extent.

Meeting Street School Pre-School Programs

For a number of years, Meeting Street School has been conducting pre-school classes for children with documented neurological dysfunction, using a teacher-therapist team approach. This team consists of a special education teacher, physical therapist, occupational therapist, and speech and language therapist (Denhoff-1967). The therapists have adapted and broadened individual therapeutic techniques for pre-school groups; the teachers have approached pre-school educational activities from a point of view of the motor and language skills involved. Together they are evolving curriculum which provides organized learning experiences in the various modalities of information processing, incorporated in pre-school group activities. For example, body awareness and control training includes development of muscle strength, bilateral use of the body, body image, precision of moving the body in space, and directional concepts — all combining to produce efficient body integration (D'Wolf & Donnelly).

The visual-perceptual-motor training includes heightening of sensory awareness, training in perception of form and spatial orientation, training in fine motor coordination, increasing visual organization skills, and stimulating correct sequencing and directionality in visual processing (Komich & Noyes). The language training includes strengthening auditory attention, discrimination, retention and sequencing; helping the child to use language as a conceptual tool by exploring the properties of materials, actions and ideas; and training the child in expressive language and motor speech skills to produce precisely-articulated, well-formulated language (Seideman; Scory, Lieberman & Hunt).

OBJECTIVES

Develop Interlocking Screening Tests of Psychoneurological Efficiency Suitable for Administration by the Head Start Physician and Teacher:

The test battery will provide the means for early identification of the sizable percentage of Head Start children whose inefficient information processing skills interfere with their cognitive development and ability to capitalize on educational opportunities. Such an analysis of the child's skills will increase the understanding of individual children and provide a more complete basis for programming and assessment of compensatory intervention.

Part of the strategy in the proposed test development is to capitalize on the interlocking skills of the physician and teacher. Thus, a conceptual framework is provided in which the observations of both physician and teacher can be systematized to provide a comprehensive picture of the child's psychoneurological skills and needs. It is anticipated this will lead to greater understanding, mutual appreciation and effective collaboration between these two professionals who, traditionally, have seen their respective jobs as complementary but quite separate. We feel that it is important for the physician to better understand how efficiency in functional sensory and motor systems of the body provides the basis for the skills the teacher is trying to develop. Likewise it is important for the teacher to better appreciate how the motor and language activities she is presenting in the classroom are dependent upon the intactness and smooth functioning of biological-neurological equipment.

Prepare A Curriculum to Develop Psychoneurological Information Processing Skills Necessary for Cognitive Development and Academic Success:

The overall aim is to utilize what is known in the area of learning disabilities and cultural deprivation in general, and Meeting Street School's experience in pre-school programming for the psychoneurologically inefficient child in particular, to create a new program for strengthening the information processing skills of the disadvantaged child. The program is unified with the screening tests by information processing theory. By systematically developing the three basic information processing modalities, the curriculum provides a wide base for cognitive development and later academic success.

Investigate the Inter-Relationship(s) of Psychoneurological Inefficiencies and Other Relevant Factors:

Data will be collected on various psychoneurological skills (from peripheral sensory-motor to central integrative processes) and group IQ scores for a large sample of disadvantaged and middle class children. In addition, there will be school achievement scores on six and seven year olds in the year of the grant and subsequently on all children as they are followed into the primary grades. Finally, detailed information on neurological involvement and social deprivation will be available for a selected sample of disadvantaged and middle class children. Although the full exploration of the inter-relation of these factors is beyond the scope of this research report, some preliminary findings are discussed.

PROCEDURE

DEVELOPMENT OF THE SCREENING TESTS

In a recent paper presented at the 1967 American Academy of Pediatrics, an approach to test development was outlined in detail, with examples of item selection techniques (Denhoff, Hainsworth and Siqueland). In essence, this approach applies a philosophy of measurement derived from the behavioral sciences to the insights of a clinical pediatric-neurological team. To produce interlocking screening tests with sufficient objectivity and reliability to predict school difficulty based on psychoneurological inefficiency, the following four steps were described.

1. Sample the widest range of functions known to affect the behavior to be predicted and obtain a cumulative score based on these functions;

2. Find individual items that provide maximum reliability, validity and efficiency;

3. Organize test items to accumulate total scores that are stable on retest and that relate to criterion to be predicted (valid);

4. Evaluate the individual child's scores through table of norms which compares his performance against others of his age, sex and other characteristics which contribute to the prediction of the complex behavior under study.

In order to sample the widest range of psychoneurological functions known to affect academic efficiency, the following model is used. It is based on the information theory model of intake, integration, output and samples a range of simple to complex levels of functioning. The simplest levels involve sensory integration in the kinesthetic, visual and auditory systems and gross motor efficiency. Based on these sensory and motor systems, the ability of the child to remember and articulate movements quickly and in the proper sequence (the patterning of movement), is evaluated in the fine motor patterning of eye-hand, ear-mouth (auditory-speech musculature) systems, and in the gross motor patterning of the large muscles of the body in space. At a more complex level, language, perceptual-motor skills and the complex integration of the visual, auditory and motor modalities (cross modality skills) provide a foundation for predicting school learning due to psychoneurological inefficiency.

Item selection is aimed at picking the most powerful (reliable, efficient and valid) items. Item reliability has been sought by making an item as objective as possible through careful selection of the behavior tested such that it can be rated by two observers to be either present or absent. A range of scores for the item is generated either by adding the number of times the child can perform the behavior or by counting the number of times he can sustain it. Quality of performance can thus be determined by objective means. An efficient item is one that will provide the maximum information with the least amount of testing time and effort. The validity of an item that purports to predict under-achievement in school on the basis of psychoneurological inefficiency should be related both to the criteria of school achievement and to neurological dysfunction, although not in a one-to-one fashion in either case. Obviously, only some children with school learning problems have a learning disorder based on psychoneurological inefficiency, and not all children with diagnosed neurological dysfunction will show difficulties in learning.

From the literature and Meeting Street School's long experience in diagnosing deviant children and experimenting with items on groups of normal children, three pools of reliable and efficient items with strong face validity were accumulated. The strategy for determining item validity involves assessing the relationship of these items to academic achievement, to neurological involvement and to these two factors combined.

Subjects:

Table 1 summarizes the characteristics of the two groups of children utilized in the item selection phase. The first group was derived from the Collaborative Study at Brown University in Providence, Rhode Island.

Table 1 — Descriptive Data on Item Analysis Samples

	N	IQ Range	Socioeconomic Level	Achievement Range
Collaborative Study Population				
Pool 1	175	57-128	78-86% Blue Collar	0.6-5.0
Pool 2	108	61-134		0.7-4.1
Pool 3	97	66-121		0.6-3.7
Total	380			
Public School Population				
Age $5^{0}-5^{5}$	20	untested	Predominantly Middle Class	untested
Age $5^{6}-5^{11}$	17	untested		untested
Age $6^{0}-6^{5}$	12	81-118		1.1-2.9
Age $6^{6}-6^{11}$	22	76-133		1.0-3.8
Age $7^{0}-7^{5}$	47	76-124		1.0-4.0
Total	118			

The items in Pool 1 were administered to 175 children prior to the grant year; the items in Pool 2 and Pool 3 were given to 108 and 97 children respectively in the year of the grant. These 380 children were all tested within one or two months of their seventh birthday, at the same time as the Seven Year Neurological and Seven Year Psychological evaluations (Collaborative Study). The IQ scores were derived from the Wechsler Intelligence Scale for Children and the achievement scores from the Wide

Range Achievement Test, both of which were administered individually by Collaborative Study personnel. Since the Collaborative Study population had been evaluated medically and psychologically from the time of the mothers' pregnancy, historical data on the children was available to the researchers through the cooperation of the Brown University Collaborative Study Director.

The second group of children came from the public schools of East Providence and Providence, Rhode Island. All 118 children were administered the items from Pools 1, 2 and 3. The 81 children between the ages of 6-0 and 7-5 had group test results on the SRA Primary Mental Abilities Test (Thurstone and Thurstone) and the Stanford Achievement Test (Kelley et al.). For both populations, the socio-economic levels were determined by reference to the 1966 census figures for fathers' occupation (United States Bureau of the Census).

The Item Pools:

Pool 1: This pool of 15 items was normed on 500 children in the East Providence school system and administered to 175 CDS children prior to the beginning of the grant. It was published in June of 1969 by Crippled Children and Adults of Rhode Island, Inc. (Hainsworth and Siqueland, 1969). Appendix 1 includes a sample record sheet from this test. However, these items were reanalyzed for possible inclusion in the two short screening tests to be developed.

Pool 2: The following 11 items were drawn from the attachment to the grant proposal entitled "Examples of Test Items Which Will Serve as the Basis for the Physician Section of the Meeting Street School Screening Test": visual discrimination, auditory discrimination, graphesthesia, visual tracking, puh-kuh-tuh, tapping rhythms, counting fingers, bilateral rhythms, stand on one foot, repetitive hand and foot tapping, cross overs (this latter was a newly added item) (see Appendix 2). These items were the result of Meeting Street School's on-going test program prior to and during the first two or three months of the grant. These items were known to have considerable reliability and many of them were already written-up in a form that could be given to children.

Pool 3: Since the third pool was to be the final pool to be tested out, all of Meeting Street's past history of test development, the published literature, and the experience of Dr. Denhoff and co-workers were all reviewed. To insure wide range sampling, items representing sensory integration, gross motor efficiency, fine motor patterning, gross motor patterning, language, visual-perceptual-motor and cross modality skills were sought. This led the authors to develop several new tests to cover areas that seemed to be lacking.

Several dozen new and old items were amassed and scrutinized as to their promise of being valid, being able to be reliably scored, and generate a range of scores for 5 and 7 year olds, and their efficiency (producing the maximum amount of information about a child in the shortest possible time with the least amount of materials and complexity of procedure for the test administrator). Further, the items were looked at for intrinsic motivational appeal, both for the child and physician or educator who might be giving the screening tests.

The following items derived from early work at Meeting Street School (Denhoff and Meeting Street School) were rejected without further trial.

stand straight
stand with arms in front
put the arms over the head
change pattern from run to skip to stop
show the teeth
put the shoulders up
open and close the mouth
turn hands over and back
walk in a circle
stand straight with the eyes closed
whistle
stand up from prone

These items have been found to be difficult to rate reliably, since a qualitative judgement is required; that is, whether there are tremors, whether movement is rapid, etc. Furthermore, although many of these items are excellent in terms of revealing neurological pathology in children, their power for a screening test is considerably limited because of the few children in the public school population who fail them (Denhoff, Siqueland, Komich and Hainsworth).

Twenty-five items, however, were field tested prior to nine being selected as appropriate for inclusion in Pool 3. These items were administered in the public school setting to about 10 children at the lowest age level (5-0 to 5-5), and about 10 at the highest age level (7-0 to 7-5). These children were previously tested with other materials and their general psychoneurological competence was known. This allowed some assessment of whether the items had promise for validity, since if inefficient or young children were doing as well on an item as efficient or older children, the item had dubious value.

Almost all of these 25 items required several modifications to find the most objective and easiest method of presentation to obtain reliable scores over the age range. In most cases, several sub parts of the item were administered and the best sections were incorporated. Where there was doubt, several sub parts of the item were kept for further testing. For example, in Pick up Sticks it was uncertain whether picking them up in the normal fashion and putting them in a box was the best way or whether picking them up and accumulating them in the hand or picking them up with the thumb or baby finger might produce a better test with a wider range of scores. In this case all three forms were kept at this stage.

Sixteen of the above 25 items were then eliminated at this stage in the item selection. These included the following eight which are a traditional part of many pediatric neurological evaluations.

Sit up - sitting up from prone position without use of the hands
Rhomberg - standing still with the eyes closed
Finger to Nose - eyes open and closed
Two point Discrimination - on the arm
Eye Pursuit - child is required to follow a moving pencil with his eyes as his chin is held still
Double Touch - touching ipsilateral or contralateral parts of the body (i. e. hand, face) simultaneously
Hand Touch - behind a screen, the fingers are touched and the child is asked to point where he has been touched
Oral Touch - the child puts his tongue where he had been touched, i. e. upper lip, corner of the mouth, etc.

Since these items are widely used and have proven clinical validity, every effort was made to find some way of having them generate a range of scores and be reliably measured so thay could be included in a screening test. They tended to be all or none tests, which the majority of children passed and very few failed; when they did fail, they did so rather completely. For example, Sit Ups seemed to have promise for being able to generate a range of scores if a number of trials were taken and the examiner could hold the child's knees and give part scores if he was able to do the test under these circumstances. Even with this method of scoring, children generally tended either to do quite well on the test or to fail it. Therefore, the discrimination power is not great and the amount of information contributed not worth the time of administration in a screening battery.

The other major problem with these items was that they were generally difficult to score reliably. For example, the Rhomberg Test would be very hard to quantify unless one had complicated equipment including a grid against the wall to measure degrees of sway. Even when a simplified grid was used, there was wide variation in observer estimates of how much sway. Because of these discrepancies the item did not seem reliable enough to be utilized, even though a range of scores could be derived by quantifying the amount of sway.

Particular effort was made to develop some test of eye tracking in the way the physician is normally used to doing it, i.e. having the child follow a moving target like the end of a pencil moved vertically, horizontally and diagonally. Again without complex instrumentation for holding the head, moving a stimulus in an objective path and recording eye movements, this item could not be properly quantified. Low reliability of judgement as to the smoothness of movements was obtained when two observers watched a child's performance. Further, administration varied widely from examiner to examiner. Thus, while the test is undoubtedly a useful tool in the hands of a trained physician, it cannot be objectively scored and usefully incorporated into a screening battery for psycho-neurological efficiency.

Since many of these tests measure important aspects of the child's neurological intactness, an attempt was made to find more objective and less traditional ways of evaluating these same functions. Thus a visual tracking item seemed more effective and reliable for a screening test than eye pursuit (see MSSST 2). The child's balance, muscle strength and motor planning assessed through the Sit Ups, Rhomberg, Finger to Nose, and sensory discrimination (Two Point Discrimination and Double Touch) appear to culminate in the child's being able to move his body more effectively in space, which can be measured more globally through items such as Gait Patterns, Clap Hands and Hand Patterns (see Pool 1), Stand on One Foot, Cross Overs (Pool 2). The previously mentioned items then provide back-up evaluation which can be used by the trained physician to study children in depth who demonstrate difficulty on a screening battery.

The second group of eight items eliminated were new items developed by the authors either to replace traditional pediatric neurological items or to measure particular skills that in our theoretical framework seemed to be neglected.

Flashlight Figures. This test was another attempt to measure efficiency of rapid eye movement. In a darkened room the physician 'wrote' forms, numbers and letters on the wall with a flashlight and the child was to identify or copy them with his flashlight. While this item showed some promise, it proved to be cumbersome to give since a large space which could be darkened and two flashlights were needed. The item was difficult to administer reliably since examiners might 'write' at different speeds, and the flashlights might give off different intensities.

Speech Diadokokinesis. This item was tried out as a possible replacement of Puh-Kuh-Tuh since at one point this item was difficult to administer reliably. It involved the child repeating over and over certain sound or word combinations, like dee-doh, or animal man. When a reliable way to administer Puh-Kuh-Tuh was found, its superior power and range in field testing made Speech Diadokokinesis obsolete.

Kinesthesia to Writing. This test involved holding the child's finger and tracing letters and numbers behind a screen so the child could not see the process. The child was then asked to write the letter or number on a piece of paper. This was a variation of Graphesthesia and Traced Figures at a simple level and was an attempt to break down the very complex skill involved in Traced Figures (which involves kinesthetic input, integration to a visual image, and encoding through a motor pattern with the hand). While the item is undoubtedly interesting, it seemed to have limited usefulness for a screening battery of the type being developed. The more global Graphesthesia or Traced Figures proved much more powerful.

Auditory Closure. This item was aimed at measuring the ability of the child to draw together (closure) disperate or garbled auditory stimuli into meaningful language. It was meant to parallel Visual Integration in the auditory sphere. This technique has been useful in older children, where sound blending tests are very common on remedial reading diagnostic batteries. Three or four forms of this test were tried: whispering in loud tone, talking with a pencil between the teeth or the hand cupped over the mouth, saying words in parts (like champ breaks down into chuh-am-puh), a running tape recorder at different speeds, etc. However, none of these methods proved simple and relevant to the age child for which the test was being developed and, regretfully, attempts to measure this important area were given up. Again, the more global tests, such as Repeat Words and Repeat Sentences, were felt to contain elements of auditory closure and hence reduce the need for a special test in this area.

Pictures to Poses. In an effort to tap the cross modality skills involved in moving from visual cues of body position to the actual body positions, little cards of human figures were drawn and the child was asked to pretend this was a person in front of him and that he should assume the same bodily position as seen in the picture. Unfortunately, this was too simple a task to generate a range of scores even for five and six year olds. Again, the more complex tests such as Clap Hands and Hand Patterns, in which a child has to observe the examiner go through a bodily movement and repeat it, were more powerful tests at this level.

Body Sequencing. This was an effort to measure sequential awareness of body parts. The examiner told the child that he would touch him several places and the child should touch himself in the place that should come next, i. e. the examiner touches the left leg, right leg, left arm.... the child should touch his right arm; shoulder, finger, hip..... and the child should touch his toe. This test proved cumbersome to administer and to 'get across' to the children. It was decided to use more complex tests such as Follow Directions I instead of this more simple test.

Birch Auditory Visual Test. A test in which a child listens to tapped sequences and then points out their visual equivalents on a card has been reported (Birch). Although several ways of administering this test in a simple form were tried, this task was beyond comprehension for the five or six year old child.

Reverse of the Birch Test. An attempt was made to measure the visual to auditory translation by having the child do the reverse of the Birch test: that is, to present a card with a visual stimulus (as in Morse Code) and have the child tap the pattern. Again this proved too difficult for the five year old.

Thus from the several dozen items considered and/or field tested, only nine items were deemed valid, reliable, or appropriate for the age range. These nine tests were included in Pool 3 (see Appendix 3) as follows:

Repeat Phrases
Pick Up Sticks
Tongue Movements
Find Forms
Match Forms
Finger Pursuit
Wind Spool
Inkblots
Traced Figures

Analysis of the Three Item Pools

The items in the three pools were analyzed for reliability, validity and area sampled using the Collaborative Study and Public School populations. A summary of this analysis appears later in Tables 3, 4 and 5.

The reliability of each item was determined by the inter-rater concordance percentages. These figures were computed by summing the number of agreements between two raters on each judgement for each part of the item, dividing by the number of judgements made and multiplying by 100. A sample of 15 children was employed for Pool 1, 11 for Pool 2, and 12 for Pool 3.

Establishing the validity of each item and its parts primarily used the achievement, neurological, and achievement-neurological analysis of the Collaborative Study population, corroborated by the achievement analysis from the Public School population. The Collaborative Study population allowed evaluation of the power of the item in terms of discriminating high from low achievers, children with evidence of neurological involvement versus those with little such evidence, and a combined validity index made up of children with high achievement and little evidence of neurological involvement versus those with low achievement and considerable evidence of neurological involvement. The public school data allowed comparison of high and low achievers.

Of course, most of the items in the item pools were considered to have strong face and clinical validity because they had been used at Meeting Street School in evaluating the function of children with neurological handicaps. Each item has been administered many times by the three research investigators and varied to maximize the item's ability to draw out the particular deficiencies of the psychoneurologically inefficient child. The statistical procedure described in the following four sections on achievement, neurological and combined factors involves a rough comparison of low and high groups. The authors realize that percentage difference figures obtained by comparing the children in low and high thirds on each factor is a crude measure and one where great accuracy is not possible because of the sample differences in the Pool 1, 2 and 3 Collaborative Study populations and the difficulty of assigning median cut-off points to low scoring items. For these reasons, ratings based on the numbers, rather than the numbers themselves, are recorded in Tables 3, 4 and 5. However these procedures were considered powerful enough for a rough comparison of items. Since very few items were discarded and since the discarding was often done on other than validity grounds (since most of the items were of good quality), such group comparison procedures were adequate. The validity analysis actually had more use in helping the authors pick strong item parts. At a later date, when local facilities permit, it is planned to compute the 140 correlations necessary to assess the relationship of each item to the four predictions (two of achievement, neurological index and combined factor).

Achievement Analysis (Collaborative Study). On the basis of data from all three item pools, cut-off points were established for defining a group of high achievers and a group of low achievers from the Collaborative Study seven year olds. The cut-offs divided the group into thirds: WRAT achievement scores of 2.0 or above (high achiever group) and 1.4 and below (low achiever group). The power of each item in discriminating low from high achievers was determined by comparing the percentage of children in these low and high groups receiving a score above the median for the total group. For example, if 20% of the children in the low achiever group obtained a score above the total group median and 50% of the high achiever group obtained a score above the total group median, the percentage difference would be 30%. These percentage differences ranged from less than 0 to 70 for the items in the three pools. An item was judged questionable (Q) if the criteria groups were less than 10 percentage points different in the expected direction, moderate (M) if 10 to 20 percentage points different, good (G) between 20 and 40 percentage points, and excellent (E) if above 40 points. This rating is coded in Tables 3-5 in the first column of the Validity Analysis.

Neurological Involvement Analysis (Collaborative Study). The second validity criterion utilized the degree of neurological involvement of each of the children. As indicated, the Collaborative Study children had been studied since before birth. Over 90 percent of the children in the three item pool groups had Form OB 60 (pregnancy information), Ped-8 (medical evaluation at birth and first five days of life), Ped-76 (7 year neurological evaluation), and the Seven Year Psychological which included the Wechsler Intelligence Scale for Children, Bender, one ITPA subtest, a Tactile Finger test, the Goodenough-Harris, and a behavior rating scale.

Each of the medical schedules (OB 60, Ped-8, Ped-76) were rated independently by Dr. Denhoff and three other physicians chosen by the

Collaborative Study medical staff for their competence in Obstetrics or Pediatric Neurology. Using these ratings, Drs. Denhoff, Forman, and the project co-directors assigned a numerical score to each item on the OB 60, Ped-8, and Ped-76 schedules. In addition, the project co-directors established an index of minimal cerebral dysfunction from the information available from the Seven Year Psychological evaluation. A combined Neurological Index score based on these medical and psychological ratings was computed for each of the 380 children in the Collaborative Study samples. The range of scores on the OB 60, Ped-8, Ped-76 and Seven Year Psychological schedules were 0 to 10, 0 to 30, 0 to 8 and 0 to 45 respectively. It was Dr. Denhoff's and the project co-directors' assessment that the schedules with the smaller ranges (OB 60 and Ped-76) had less to contribute to an overall Neurological Index than schedules with the larger range; therefore, using a summed total from these different schedules was deemed justified. It had been hoped that the Ped-76 schedule would provide a wider range of scores, but this proved to be a disappointing measure of seven year old neurological status and function.

Using this combined Neurological Index, cut-off scores were set at 38 and above for children with a high degree of neurological involvement and 29 and below for a group of children with a low degree of neurological involvement. Thus, the Collaborative Study children were divided into three groups in terms of degree of neurological involvement. The power of each item in discriminating between groups of children with high versus low neurological involvement was also accomplished by comparing the percentage difference between these two groups in scoring above the total group median on the particular item. These percentage differences ranged from less than 0 to 40. An item was judged questionable (Q) in power of relating to neurological involvment if the criteria groups were less than 5 percentage points discrepant in the expected direction, moderate (M) if from 6 to 10 percentage points different, good (G) if from 10 to 20 percentage points different, and excellent (E) if there was a 20 percentage point difference or more.

Combined Achievement and Neurological Analysis (Collaborative Study). Since the major purpose of any item is to predict children whose school achievement will be hampered by psycho-neurological inefficiency, the most important criterion for item selection is a combination of these two validity factors. For the purposes of this third validity analysis, the 380 Collaborative Study children were divided into low, medium and high groups. The high group had good school achievement (2.0 or above) and a low Neurological Index (32 and below). The low group had inadequate achievement (1.6 and below) and a high Neurological Index (33 and above).

As in the previous two analyses, the percentage point difference was compared between the low and high groups in scoring above the total group median for each item in the three pools. The range of percentage point difference was from less than 0 to 67 in the predicted direction. Power ratings for the item in discriminating between these two groups of children was made as follows: questionable (Q) 0 to 10 percentage points difference, moderate (M) 10 to 20, good (G) 20 to 30, excellent (E) 30 plus.

Achievement Analysis (Public School Children). The 118 public school children were administered all three item pools. This data was used to check the Collaborative Study analysis of achievement validity. Scores were available on the Stanford Achievement Test (Kelly et al) administered by public school personnel as part of the regular group testing program in the schools.

As in the achievement validity analysis using the Collaborative Study population, the Public School population was divided into high, medium and low achievement groups on the following basis. The high achievement group had Stanford Achievement Test scores of 2.1 and above, the low group had scores of 1.6 and below. Again the percentage point difference between the high and low groups scoring above the total group median were calculated and ratings assigned as follows: questionable for less than 10 percentage points different in the expected direction, moderate for 10-20 points, good for 20-40 points, and excellent for above 40 points. This rating is listed in the fourth column of the Validity Analysis found in Tables 3-5.

The above analysis was carried out for the items in Pools 2 and 3. However, for Pool 1, items correlational data obtained prior to the start of the grant was available on a normative sample of 500 East Providence children (Hainsworth and Siqueland). Ratings of these correlations were made on the following basis: 0-10 questionable, .11 to .20 moderate, .21 to .30 good and over .30 excellent.

Selection of the Physician-Educator Screening Tests. Items for these two inter-locking screening tests were selected on the basis of the above analysis of the three item pools. Items were analyzed by the area or areas sampled, inter-rater concordance, and relationship to the achievement, neurological and combined criteria in the Collaborative Study population and the achievement criteria in the Public School population.

Development of Tables of Norms

The items selected to comprise the Physician and Educator screening tests were then administered to over 600 children in the Providence and East Providence school systems during the months of March through June. In order to develop a representative sample of children in the age range of 4 1/2 to 7 1/2 years as well as a sample of disdavantaged children, kindergarten and first grade classrooms in seven schools in East Providence and four schools in Providence were chosen to provide the widest possible range of socioeconomic levels.

The seven schools in East Providence were known from previous test development (Hainsworth and Siqueland) to sample the occupational categories outlined in the 1966 U.S. Census Figures in a rough approximation of the relative percentages for these occupations. The schools are found in every area of the town which has a population of nearly 50,000. While negro children are included in this sample, they are often middle class, having moved from inner city areas such as the south side of Providence. Of the four schools in Providence, three are located in the inner city (south side) area which houses most of the deprived negro children in Rhode Island. The fourth school is located on the East Side of Providence, and serves a heterogeneous group of children from a deprived pocket in the midst of an affluent white community which includes Brown University professors.

Using the U.S. Census figures for fathers' occupations as a guideline, the following percentages determined the selection of the normative sample selected in each half-year age level from 4 1/2 to 7 1/2 years.

1	Professional and technical workers	14%
2	Managers, officials and proprietors	14%
3	Clerical and kindred workers	7%
4	Sales workers	7%
5	Craftsmen, foremen and kindred workers	19%
6	Operatives and kindred workers	21%
7	Service workers	7%
8	Laborers	6%
9	Unemployed or unclassified	5%

In addition to this normative sample of the general population, a sample of disadvantaged children at each half year age level was selected to form a comparative sample. Disadvantaged children were defined as falling in categories 6, 8 and 9 (laborers, operatives, unemployed and unclassified) from the children residing in both Providence and East Providence.

Preliminary Studies of Screening Test Validity and Reliability.

Just as the validity criteria of school achievement and neurological involvement allowed study of the individual items and their parts, the same criteria were used to study the validity of the two screening batteries. Since the major work of the grant was the development and norming of these two screening tests, only preliminary analysis of test validity has been undertaken. More extensive studies are planned.

On those first grade children in the normative sample for whom data was available, Pearson Product Moment correlation coefficients were computed between Stanford Achievement Test (Kelly et al) scores and the children's scores on the Physician, Educator and Total screening test. In later years, more scores on more of these children will be available for follow-up.

The relationship between the above three screening test scores and neurological involvement was examined in a preliminary way by administering the screening tests to 19 children with known neurological impairment. All of these children were between the ages of 4 1/2 and 7 1/2, and of 85 IQ or more, and had documented hard signs of neurological impairment on previous pediatric neurological evaluations by Dr. Eric Denhoff of the Meeting Street School staff. The scores for each of these 19 children on the Physician and Educator screening test and on the Total were compared with the mean score of a child of comparable age and socioeconomic status (blue collar versus white collar). A t test of difference of means between the 19 pairs of scores was calculated.

The reliability of the Physician and Educator screening tests was determined by the following procedure. In testing the normative sample, the items for the two screening tests were combined into two batteries--one primarily made up of physician items and one primarily of educator items. In determining inter-rater reliability, two research assistants independently scored the performance of 15 children on battery 1 and 15 children on battery 2, and Pearson Product Moment correlation coefficients were calculated for each 15 pairs of scores. Test-retest reliability was assessed by retesting 30 children with battery 1 and 32 children with battery 2 three to five weeks following the first presentation. Again correlation coefficients were calculated between the two sets of scores.

INVESTIGATION OF FACTOR INTERRELATIONSHIPS

While the focus of the research was the development of screening tests, several measurements on a large number of children were available for comparison with other data on the same children. The relationship of cultural deprivation to various psychoneurological functions is of particular interest. Data is available on three socioeconomic groupings: the representative sample of the general population, the culturally deprived sample of operatives-laborers-unemployed, and a hard core deprived group of laborers and unemployed from the inner city of Providence. The comparison of mean scores for these three groups on the Language, Visual-Perceptual-Motor and Body Awareness and Control subtotals as well as the Physician and Educator and Total screening tests has been made using t test analysis. Further, on those children for whom group achievement, readiness, and IQ test scores were available, the inter-correlations between these scores and age, socio-economic level and the above screening test scores were determined.

DEVELOPMENT OF THE CURRICULUM GUIDE

From the experience gained by the therapists and teacher working with the nine children in the research classroom, a psychoneurologically-oriented curriculum guide for the observation and teaching of the disadvantaged pre-school child was written. Under the chairmanship of the Research Co-directors, weekly meetings with the grant staff were held to discuss educational philosophy, plan classroom directions, and prepare task analysis breakdowns of activities in the three modalities of Body Awareness and Control, Visual-Perceptual-Motor and Language. In addition, the Co-directors met with each group of therapists to assist them in formulating a cohesive approach to the curriculum in their specialty. In some cases, the raw material for each curriculum section was dictated in these sessions following extensive discussion. Dr. McMahon, our educational consultant, met primarily with the Research Co-directors and the Teacher to discuss the literature on preschool education and react to Meeting Street School's point of view on curriculum. The final curriculum guide was edited in its entirety by the Research Co-directors.

A summary of Meeting Street School's evaluations of the nine East Providence children and recommendations for future educational directions was reported in a meeting with the Assistant Superintendent of Schools. In addition, detailed reports are being sent to the school system. Feedback interviews were held with each parent at the end of the year and reports of our findings were sent to the family doctor and medical coordination initiated with him where possible.

RESULTS

DEVELOPMENT OF THE SCREENING TESTS

The individual items chosen for the two screening tests are discussed in detail since their development was the focus of the research. Following this, the composition of the normative sample and the culturally deprived groups is presented along with preliminary tables of norms for the evaluation of performance on the two screening tests. Finally, validity studies on the tests prediction of school achievement and neurological involvement and test reliability studies are summarized.

Items Included in the Screening Tests

Table 2 presents an overview of items selected for the Physician and Educator screening tests. The first and third columns list those items which are specifically designed for the Physician and for the Educator. In the middle column are those common items which are included in both screening tests.

Table 2: Item Composition of the Physician and Educator Screening Test

	PHYSICIAN	COMMON	EDUCATOR
LANGUAGE	Auditory Discrimination Puh-Kuh-Tuh Tapping Rhythms	Repeat Phrases Repeat Sentences	Counting Sequencing
VISUAL PERCEPTUAL MOTOR	Find Forms Wind Spool Traced Figures Touch Fingers	Match Forms	Follow Directions II Copy Visual Integration
BODY AWARENESS AND CONTROL	Cross Overs	Clap Hands Gait Patterns	Follow Directions I

To administer the Physician Screening Test, present the 13 items in the physician and common item columns. The Educator Screening Test is comprised of the 11 items in the educator and common item columns. Each requires 15-20 minutes to administer; the entire battery of 19 items takes approximately 30 minutes. It is expected that if the teacher and physician were screening children at the same time, a division of labor would occur since the common items would not be administered by both examiners. The idea of a set of common items to be added to both the Physician and Educator tests arose from discovering that in the three items pools, several items fell between the more discrimination-skill items of interest to the physician and the pattern-intergration items of prime concern to the educator. In many cases, two items were included in the item pools to cover each of these common areas. Rather than include two sets of items to sample similar functions in the scale (one set for the physician and one for the educator), it was decided to pick the most powerful for the common section which could be added to both the Physician and Educator tests.

In addition to having the physician and educator share responsibility for testing a broad spectrum of psychoneurological inefficiency (from sensory integration and fine and gross motor skills to patterned and integrated use of these skills), their testing efforts are unified as to the modalities tested. In each of the Language, Visual-Perceptual-Motor and Body Awareness and Control modalities, the physician and educator can derive subtotal scores. Whether these scores will prove reliable and valid enough to warrant normative tables will be assessed at a later date. However, the educator and physician can pool their test results to sample a broader range of psychoneurological function in each modality as well as by total score.

The items in the Language modality survey sensory integration (Auditory Discrimination and Tapping Rhythms), fine patterned movement (Puh-Kuh-Tuh) and their use in varying complexities of language skill (from Repeat Phrases and Repeat Sentences to Count-in Sequencing). The Visual-Perceptual-Motor modality surveys fine patterned movement (Wind Spool and Touch Fingers), eye-hand coordination or sensory integration to fine patterned movement (Find Forms and Traced Figures), as well as various levels of visual-perceptual-motor efficiency (Match Forms, Visual Integration, Copy and Follow Directions II). Similarly, the surveying of information processing skills in the Body Awareness and Control modality covers gross motor efficiency (Cross Overs), gross motor patterning (Gait Patterns) and the cross modality skills of sensory integration to gross motor patterning (Clap Hands and Follow Directions I).

The 19 items in Table 2 were selected from the 35 items in the three pools because these items sampled the range of psychoneurological efficiency in the most powerful manner. In making the final selection, the item analysis data presented in Tables 3, 4, and 5 allowed rough comparison of items measuring similar functions as to their relative objectivity (inter-rater concordance) and their relationship to the validity criteria of school achievement and neurological involvement.

As well as picking the most powerful items which would sample a wide range of psychoneurological function, the item analysis date allowed an inspection of the parts of items. Originally in the item testing phase, more parts of items were kept than were needed. By looking at the power (objectivity and validity) of each part and the percent pass figures for children at the six half-year age levels, it was possible to make a selection of item parts that would generate a range of scores for young (4 1/2 to 6) and older (6 to 7 1/2) children and maximize the prediction of the school achievement and neurological validity criteria. In addition, the total possible score for each item was kept within a range of 6 to 8 points, with one or two purposeful exceptions. Items generating more scores (because they measured number of seconds or times an act was accomplished) were scaled to fall in the 0-8 range.

Each of the eight items in the exclusive Physician section, the five items in the Common Section and the six items in the exclusive Educator Section will be discussed in detail. The following topics will be covered on each item: area of psychoneurological function sampled, inter-rater concordance and validity ratings achieved in item analysis, history of pilot work to develop the item, and selection of item parts to produce the final item form. Of the 19 items, 12 are entirely original and never been used by other examiners. Seven items are greatly modified versions of

Table 3: Pool 1 Item Analysis

			Validity Analysis				
Item	Area Sampled	Inter-Rater Concordance	Achievement (Collaborative)	Neurological (Collaborative)	Achievement-Neurological (Collaborative)	Achievement (Public School)	Decision
Gait Patterns	Gross Motor Patterning	95	G	G	G	M	Common
Clap Hands	Sensory Integration - Gross Motor Patterning	100	E	E	E	G	Common
Hand Patterns	Sensory Integration - Gross Motor Patterning	96	G	G	G	M	Deleted
Follow Directions I	Body Awareness and Control	96	G	E	E	E	Educator
Touch Fingers	Fine Motor Patterning	96	E	E	E	G	Physician
Block Tapping	Visual-Perceptual-Motor	100	M	Q	Q	M	Deleted
Match	Visual-Perceptual-Motor	99	G	G	G	M	Deleted
Memory	Visual-Perceptual-Motor	100	E	E	E	G	Deleted
Copy	Visual-Perceptual-Motor	93	E	E	E	M	Educator
Follow Directions II	Visual-Perceptual-Motor	95	G	E	E	E	Educator
Repeat Words	Language	97	E	E	E	G	Common
Repeat Sentences	Language	97	E	E	E	E	Common
Counting	Language	97	E	E	E	E	Educator
Tell A Story	Language	93	G	M	M	Q	Deleted
Sequencing	Language	99	E	E	E	E	Educator

Table 4: Pool 2 Item Analysis

Item	Area Sampled	Inter-Rater Concordance	Validity Analysis				Decision
			Achievement (Collaborative)	Neurological (Collaborative)	Achievement-Neurological (Collaborative)	Achievement (Public School)	
Visual Discrimination	Visual-Perceptual-Motor	98	M	Q	Q	G	Educator
Auditory Discrimination	Sensory Integration	100	E	G	M	E	Physician
Graphesthesia	Cross Modality	100	G	G	M	G	Deleted
Visual Tracking	Fine Motor Patterning	99	M	G	Q	G	Deleted
Puh-Kuh-Tuh	Fine Motor Patterning	93	E	E	E	M	Physician
Tapping Rhythms	Cross Modality	91	M	G	Q	G	Physician
Counting Fingers	Cross Modality	99	E	E	E	G	Deleted
Bilateral Rhythms	Cross Modality	99	E	Q	E	E	Deleted
Stand One Foot	Gross Motor Efficiency	94	M	E	M	M	Deleted
Repetitive Hand-Foot Taps	Gross Motor Efficiency	91	M	Q	E	G	Deleted
Cross Overs	Gross Motor Efficiency	98	G	M	M	M	Physician

Table 5: Pool 3 Item Analysis

Item	Area Sampled	Inter-Rater Concordance	Validity Analysis				Decision
			Achievement (Collaborative)	Neurological (Collaborative)	Achievement-Neurological (Collaborative)	Achievement (Public School)	
Repeat Phrases	Language	90	E	G	E	G	Common
Pick-Up Sticks	Fine Motor Patterning	97	G	G	M	M	Deleted
Tongue Movements	Fine Motor Patterning	95	M	Q	M	Q	Deleted
Find Forms	Sensory Integration - Fine Motor Patterning	98	E	G	E	G	Physician
Match Forms	Visual-Perceptual-Motor	100	M	G	G	M	Common
Finger Pursuit	Fine Motor Patterning	99	G	M	G	G	Deleted
Wind Spool	Fine Motor Patterning	98	G	G	G	M	Physician
Inkblots	Visual-Perceptual-Motor	no data	G	G	G	no data	Deleted
Traced Figures	Cross Modality	no data	G	G	G	no data	Physician

functions that have been assessed in other ways by other clinicians or test developers.

Physician Section

P 1. Auditory Discrimination (from Pool 2). Auditory discrimination is a unique item sampling sensory integration in the Language modality. The child must point to one of four or five pictures which portrays the object which the examiner names, (outside the child's visual field).

From Table 4, it may be seen that this item had 100% inter-rater concordance. The validity predictions of school achievement in the Public School and Collaborative populations are rated excellent, while the prediction of the Neurological Index Score falls in the good range. Somewhat surprisingly, the combined achievement-neurological validity rating is only in the moderate range. This finding that the rating on the combined factor is lower than of either factor alone is true of several other items: it may be due to the fact that in selecting a low and high group on the combined factor, the cut-off points were closer to the mean for each factor than when the factor was used singly.

Considerable pilot work was necessary in order to find a method of measuring this skill in young children. Many of the common techniques (i.e., Wepman) involve the examiner saying pairs or double pairs of words which the child has to identify as the same and different. This is generally inappropriate for young children who do not have the concept of same and different and whose auditory attention span is limited. Thus, the authors devised a method involving the child identifying a pictorial representation of a stimulus word spoken by the examiner from five possible representations on a card. Among these is an alternative picture which portrays a common discrimination error that the child might make, i.e., shake versus snake. The examiner says "Shake" and the child must point to the picture of shake (correct discrimination) instead of snake (distracter). Each Card has the two discriminations, two distracters, and one irrelevant figure (Card 7 has two distracters for the original discrimination). While this method of presentation does involve visual scanning and interpretation of the pictures, an artist was employed to draw these pictures in as clear a form as possible to make the visual problem an easy one for the child to solve. The words and pictures were designed to be of common objects within the knowledge of four to seven year old children from a wide range of cultural backgrounds.

Originally, 7 cards were used in this task, allowing for 14 discrimination problems to be presented since two stimulus words are given per card. In analyzing the data, two of these cards were found to be too easy for even the youngest age group and were therefore deleted. Since items were generally designed to generate scores of 8, a third card with the discriminations bag and pen was also deleted because these showed the least power in relating to the validity criteria.

The final design of the item involves the use of four cards with two discriminations each, for a total possible score of 8.

Card 3a Shake - Snake
b. Shoulder - Soldier

Card 4a Half a ball - Have a ball
b Crown - Clown

Card 5a Three tops - Tree tops
b Ask - Axe

Card 7a Feed - Feet
b 4D's - Forties, (4T's)

P 2. Tapping Rhythms (from Pool 2). Tapping rhythms is a cross modality task in which an auditory stimulus must be translated into a motor response. The examiner taps a rhythm out of sight of the child, who must then replicate the rhythm by tapping the same pattern on the table. The authors feel that the sensory integration aspect of this item is primary since remembering the auditory sequence of beats is the major challenge. Motor reproduction is certainly also involved, but appears considerably easier than the sensory integration component.

From Table 4, it may be seen that Tapping Rhythms has adequate inter-rater concordance (91%). It shows good to moderate discrimination of high versus low achievers and good discrimination of children with neurological dysfunction; however, its rating on the combined factor was in the questionable range. The item as a whole thus had somewhat variable validity ratings; however, in view of its unique properties, it appeared worthy of inclusion in the final test battery.

Items similar to Tapping Rhythms are found in the test literature in various forms. The cross modality aspect embodied in this item was popularized by Birch in another form, i.e., an auditory input to be recognized in its visual representation. Other investigators (such as Englemann) have also found this a useful task. In order to make tapping rhythms applicable to young children and easy to administer, considerable pilot work was required. Field testing indicated that young five year olds could handle a 2 beat tap followed by 2 one beat taps and seven year olds needed much more complicated and longer rhythmic patterns.

The primary difficulty in constructing a viable test, however, was to find a format which was not too difficult to administer and score in a standard fashion. In our experience, physicians who use this test make up patterns to suit the level of each child or use a few standard rhythms that they themselves have developed. In constructing a test that could be easily learned and replicated by other physicians, it was discovered that these rhytms are complicated to write down. The authors experimented with several visual symbol methods including a Morse Code format, a system of short and longs divided by bars as in music. However, it was found that suitable rhythms were hard to put into these formats and many examiners did not know how to reproduce them. Thus, examiners found this an annoying and time consuming item to learn to administer in a standard manner.

The authors then found a simplified method of transmitting the particular rhythms, that of using a known musical tune as a mediator. Thus, one item involved a short short long, short short long rhythm. In addition to writing the words short and long, it is simple to put in parenthesis the tune which embodies this rhythm,

i. e., Jingle Bells. Knowing this not only helps the physician give the item in a standard fashion but also makes it easy for him to remember the test. Instead of having to constantly refer to a lot of complicated long and short patterns, he can quickly learn the three or four tunes which are the basis of his presentation. With this modification, the test changed from being an extremely difficult item (one that normally would have been discarded on this basis) to an item which became feasible to administer.

Several ways of scoring this test were investigated during field testing, including part scoring various sections of each rhythm and scoring each on an all-or-none basis. Since it was very difficult for the examiner to part-score rhythms, it was decided to score each pass-fail, but give two trials where the child failed the first.

For the physician screening test, four item parts were utilized: three from the pool 2 item plus one additional part added to provide a continuous range of difficulty. These four parts are as follows:

1. Long/Short Short (count 1 2/3 4 evenly)
2. SSL, SSL (Jingle Bells)
3. SSLLLL (Oh say can you see).
4. LSLSSSSL (All around the Mulberry Bush).

Each part is scored 2 points for success on the first trial, 1 point for success on the second trial, or 0 points for no success on either trial. The possible score is 8 for the item.

P 3. Puh-Kuh-Tuh (from Pool 2). This item samples the area of fine motor patterning and hence is an output skill in the Language modality. It tests the efficiency of the oral musculature in producing the labial sound (p), the velo-pharyngeal sound (k), and the dental sound (t) in rapid sequential patterns. This was not a unique item since Tongue Movements from Pool 3 also is a fine patterned movement item in the language output area, involving moving the tongue up, down, right, left, and from side to side and up-down in sustained rapid movement.

It may be seen from Table 4 that the inter-rater concordance of Puh-Kuh-Tuh is adequate (93%). It obtains an excellent rating in its relationship to achievement, to the neurological index, and to the combined achievement-neurological factor in the Collaborative Study population. In the Public School population achievement validity analysis, Puh-Kuh-Tuh did somewhat less well. By reference to the validity analysis on Tongue Movements in Table 5, it may be seen that this item received much lower validity ratings in the questionable to moderate categories. The final decision therefore, was to delete Tongue Movements and keep Puh-Kuh-Tuh.

In pilot work, Puh-Kuh-Tuh was originally somewhat difficult for examiners to administer to children in a standard fashion. To have the child begin by saying puh-kuh-tuh over and over again was generally confusing and hence unreliable; many children did not get the proper set. Further, this task was extremely difficult for the younger children. However, the item had such face and clinical validity that an effort was made to discover more suitable methods of administration. This resulted in the finding that not only for the young child but for many others, it was necessary to go through a set establishing phase for this item. If the child was first asked to say puh-kuh, and then puh-kuh-tuh, and then puh-kuh-tuh puh-kuh-tuh this overcame the difficulties mentioned above.

Other pilot work concerned finding how to measure a child's ability to keep repeating puh-kuh-tuh, puh-kuh-tuh. Field testing indicated that having the child sustain this for 5 seconds turned out to produce a reasonable range of scores and be within the interest and capability of all but the very youngest children. Since it was difficult to know how many different combinations of the puh, kuh, and tuh sounds a child should be asked to repeat, it was decided to add 5 seconds of puh - tuh- kuh and kuh - puh - tuh repetitions to the 5 second trial of puh-kuh-tuh.

In its final form in the Physician screening test , Puh-Kuh-Tuh was reduced in length by eliminating the final kuh-puh-tuh repetition. The validity analysis of the item parts indicated that all three of the repeated sequences had high relationship to achievement, to the neurological index, and to the combined factor and hence eliminating the final kuh-puh-tuh sequence would not reduce the overall predictive capacity of the item. This left the following format: 1) puh-kuh (1 point), 2) puh-kuh-tuh (1 point), 3) puh-kuh-tuh, puh-kuh-tuh (1 point), 4) number of puh-kuh-tuh repetitions in 5 seconds, 5) number of puh-tuh-kuh repetitions in 5 seconds.

Since the scores for this item could range from 0 to over 20, it was necessary to provide some transformation scores if this item was to be added numerically to scores from other items, which were in the range of 0-8. To transform the scores, the percentages of children achieving each raw score, from 0 to over 20 for each of the six age groups from 4-6 through 7-5 were added together. Then, the 0 to 20 scores were compressed into a 0-8 bell-shaped distribution, so that approximately 2% of children would score 0, 4% score 1, 8% score 2, 18% score 3, 36% score 4, 18% score 5, 8% score 6, 4% score 7, and 2% score 8. It may be seen that the majority of children will obtain scores of 3 through 5 and that if a child has a score of 7 or 8, he is very efficient on this item and if he gets a score of 1, or 0, he is very inefficient. On this basis, raw scores (in the 0-20 distribution) of 0 or 1 were assigned a transformed or scaled score of 0, raw scores of 2 and 3 a score of 1, 4 to 6 a score of 2, 7 to 8 a score of 3, 9 to 12 a score of 4, 13 to 14 a score of 5, 15 and 16 a score of 6, 17 and 18 a score of 7, and 19 plus a score of 8. This transformation could be recorded directly on a score sheet so that all an examiner has to do is total up the raw scores which the child gets in the five parts of the item and circle the appropriate scaled score 0 through 8. This transformation could then be accomplished by any examiner in a couple of seconds.

P 4. Wind Spool (from Pool 3). Wind Spool is a fine motor patterning item which samples some output skills in the Visual-Perceptual-Motor modality. It requires the motor planning and eye-hand coordination necessary to quicly wind a string around an empty thread spool. This item was one of several in the three pools measuring various aspects of eye-hand coordination: Pick-up Sticks where the child has to pick up ten matchsticks and put them into a little box, Finger Pursuit in which the child repeatedly puts his finger in a small cup which is being rotated, and Touch Fingers and Find Forms (described later). The final decision was to keep Touch Fingers (scored out of 8), Find Forms (scored out of 8) and Wind Spool (scored out of 4) as the best sampling of this area. While Finger Pursuit showed good validity predictions, it was tiring for examiners to rotate the cup around in a circular pattern at a determined rate of speed until the child was able to put his finger in the cup a certain number of times. Further, this direct hand placement controlled by the eye was felt to be more adequately assessed in Find Forms which involved rapid back-and-forth pointing between a series of stimulus objects on a card and on a wall chart. Pick-Up Sticks was eliminated because of only moderate to good validity predictions and the fact that the skills involved seemed to be represented in the Wind Spool and Touch Fingers items which, in addition, involved fewer materials and were generally easier for examiners to administer.

From Table 5, it may be seen that Wind Spool has a high inter-rater concordance of 98%, and relates in the good category to achievement, neurological index and combined achievement-neurological predictions in the Collaborative Study sample and in the moderate category in predicting school achievement in the Public School population. Thus, its validity is acceptable even though not as high as Touch Fingers or Find Forms. This fact, combined with the more limited skills that the test tapped, influenced the test developers to score Wind Spool out of a possible 4 rather than the possible 8 and hence give it less weight in the total Physician test score.

Considerable pilot work and field testing was necessary to find a standard form of administration which would be understandable to all children within the 4 to 7 year old age range. In the final instructions, the examiner winds up the spool while saying, " Watch very carefully how I am winding this spool because I am going to ask you to do it just the way I am". The unwound spool is then placed on the table at the child's midline with a string leading away from the child. The examiner then says, "When I say go, pick up the spool and wind it as quickly as you can ....Go.". The time is scored from the moment the child places his hand on the spool till his thumb rolls over the knot at the end of the string. This form of administration was decided upon after trying many ways in which it was found that a demonstration for the child before unwinding the spool for him to wind was necessary, and that the timing of performance should occur from the moment the child picked up the spool rather than from the time the examiner said "Go" since some children would sit and stare at the spool for a few seconds before picking it up and their score did not accurately reflect their eye-hand coordination skills. For item analysis purposes, two trials of spool winding were required since the authors did not know whether just giving one trial would produce sufficient item validity.

Analysis of the validity data did indicate that a range of scores was derived from only one trial and that trial 1 seemed to have greater validity than trial 2. It was deemed unlikely that adding the second trial would increase the predictive capacity of the item. Thus the final format of Wind Spool was for one trial scored 0 to 4. Again since children's scores range from 5 or 6 seconds up to 45 or more seconds, a scaling procedure comparable to that used for Puh-Kuh-Tuh was developed. The following percentages were used to produce a roughly bell-shaped distribution: the lowest 10% would receive a score of 0, the next 20% a score of 1, the next 40% a score of 2, the next 20% a score of 3, and the top 10% a score of 4. This led to setting the following cut-off points for a transformation from number of seconds to wind the spool into the 0-4 scale: 40 plus seconds receives a score of 0, 17 to 39 a score of 1, 11 to 16 a score of 2, 9 and 10 a score of 3, and 0 to 8 a score of 4. Again this conversion could be located on the scoring sheet so that the physician could quickly make the transformation.

P5. Touch Fingers (from Pool 1). As discussed above in Wind Spool, Touch Fingers is also a fine motor patterning item in the Visual-Perceptual-Motor modality. It involves touching the fingers of both hands in sequence to the thumbs from a visual cue (examiner demonstration).

The inter-rater reliability of Touch Fingers is 96% concordance. From Table 3 it may also be seen that the item has high validity in the Collaborative Study sample, predicting achievement and the Neurological Index and the combined achievement-neurological factor with an excellent rating. The prediction of achievement in the East Providence public school population was good.

Touch Fingers has been used locally by Dr. Denhoff for many years and is in the repetoire of other pediatric-neurologists. However, on attempting to make this item objective and replicable, it was necessary to administer this item to all children in a rigid and extremely standard fashion. The child must watch the examiner deliberately bring the second, third, fourth and fifth fingers to the thumb on both hands at the same time and then do it himself, repeating it if he was successful or watching the examiner demonstrate first if he was unsuccessful. If the child could do this task hands together, a variation of the task (that is touching fingers 2, 4, 3, 5) was introduced; for those failing the hands together task, the examiner would return to see if the child could do it hands separately. It was found in field testing that the way the examiner demonstrated was very important so careful instructions for the presentation of this item are included.

Since considerable pilot work was done on this item previous to the year of the grant, the item was kept in its Pool 1 version. Thus the final format of the test involved: 1) Hands Together trial 1, 2) Hands Together trial 2, 3) Hands Separate (given if the child failed the above or credited if he passed the above), and 4) Thumb to 2, 4, 3, 5. Other methods of scoring the item were evaluated but the 8 possible scores, 2 for each of the four parts, remained the best method. No scaled score transformation was needed for this item since its scores range naturally from 0 to 8.

P6. Find Forms (from Pool 3). This item measures sensory integration primarily but also requires fine motor patterning skills in the Visual-Perceptual-Motor modality. As such, it is a measure of eye-hand coordination.

From Table 5, it may be seen that the item has high inter-rater concordance (98%); the validity ratings are generally in the good to excellent category. Find Forms shows excellent prediction of school achievement and of the combined achievement-neurological factor in the Collaborative Study and good predictions of the neurological index of this group and of the school achievement in the Public School population.

As far as the authors are able to determine, the present format has never been tried by other researchers or clinicians. Find

Forms is one of three items included in the Physician and Educator screening tests which employ the wall chart with forms drawn on it. After the child is administered Find Forms, the wall chart can be used for giving the Match Forms item and, if the whole Physician-Educator battery is being employed, the forms are also used in Visual Integration. Measurement in the Visual-Perceptual-Motor modality usually requires complex materials and work sheets which are not an accustomed or easy format for a physician or nurse. However, a wall chart can be put up in a doctor's office and makes the examination appear similar to visual acuity testing.

In field testing, it was found that two stimulus cards were necessary; one at a simple level for the young or inefficient child and one having more forms on it for the older child. Experience indicated that the best way to administer the item was to place the first card with three forms on it above the wall chart and have the physician take the child's hand and point to the first form on the card and then on the wall chart, and do the same for the second and third forms if necessary. At this point the examiner has the child do the same process, timing him from touching the first form on the card to touching the third and last form on the wall chart. It was found that even young children could perform this task, although the very young child could not generally go on to the second card. Because this was a completely new item, it was decided to keep two trials of thissecond card with eight forms during the item analysis phase.

Data from the validity analysis of the item parts using the Collaborative Study and Public School populations indicated that card 1 had good to excellent validity prediction in achievement and the combined index. Further, the first trial of card 2 likewise had good to excellent ratings. Interestingly, the second trial of card 2 proved to have even higher validity ratings. The authors were then placed in the difficult position of deciding whether the time for a second trial was worth the possible increase in item validity which might occur. The final decision was to drop the second trial as taking too long for a screening test, and as the good to excellent ratings of cards 1 and 2 gave the item enough power. This second trial was dropped reluctantly because, from clinical experience, it is often diagnostic of inefficient children to perform more poorly on such second trials.

As in other timed items, the raw scores of number of seconds to perform the task on cards 1 and 2 were transformed into scaled scores. Like the scaled scores for Puh-Kuh-Tuh described above, the same percentages in each of the 0 to 8 scores were utilized and this transformation could be located on the record form for instant scoring by the examiner.

P7. Traced Figures (from Pool 3). Traced Figures is a cross modality item involving a kinesthetic input and motor (drawing) output. It has similarities to Graphesthesia from Pool 2, which has the same input but merely involves a visual recognition response. Both of these items have been used extensively by pediatric neurologists. Recently a task similar to Traced Figures has been used by one investigator in his neurological screening test (Ozer), and it is presumed that other investigators have been working with such adaptations.

This item was only administered to the Collaborative Study sample. Further, there is no inter-rater concordance data available at this time. Field testing suggests that it is not a difficult item to rate, but if in further study the inter-rater reliability is in question, scoring samples will be prepared to reduce any unreliability. It may be seen from Table 5 that Traced Figures has good prediction of achievement, the neurological index and the combined achievement-neurological factor. From Table 4, Graphesthesia also has good ratings. The decision to utilize only Traced Figures for the Physician screening test was based on the fact that Traced Figures is a more global item involving more cross modality integration and having more surface relationship to school related skills such as writing than does Graphesthesia.

Field testing revealed that if geometric forms were used in addition to letters and numbers, the 4 1/2 or 5 year old child was able to understand and achieve a range of scores on the item. A combination of naming and tracing tasks with several geometric forms (vertical line, square, X, triangle, horizontal line, circle) and numbers and letters was tried out. Further, while some physicians prefer to draw on the child's non-dominant hand, the authors felt that the examiner should both draw on and have the child use his dominant hand, since sensory as well as motor skills of the non-dominant hand are of somewhat questionable value in the experience of the staff workers at Meeting Street School. Further, the time lapse between the examiner drawing on the child's palm and the child picking up the pencil to write introduces a desirable memory factor into this cross modality task.

Analysis of the validity of sub-parts indicated that Traced Figures could be reduced in length for the final format. It was decided that beginning the item with the vertical line, followed by a square, provided enough base for the young child and that the geometric forms all had roughly the same validity ratings. It was then decided to keep the number 3 which had high validity and add the letter S, rather than C or W as presented in the Pool 3 version which both had questionable validity. In order to have Traced Figures yield a score roughly equivalent to other items, it was decided to give 2 points for each of the four forms correctly traced, for a possible total of 8 points. It would have been possible to give 2 points for correct on first trial and 1 point for correct on second trial, as in Tapping Rhythms. However, this is a time consuming item and it was felt that the extra time was probably not warranted for a screening test.

P8. Cross Overs (from Pool 2). Cross Overs is one of three items in the area of gross motor efficiency. The other two, also from Pool 2, are Stand on One Foot and Repetitive Hand Foot Taps. Cross Overs involves the child slapping the back of one hand with the palm of the other (and vice versa) and persisting in this pattern over a 30 second period. It assesses complex alternation of hands as well as the child's stamina for this rather tiring activity. Such persistence is felt by some examiners (Ozer) to be a diagnostic measure of the neurologically impaired child, who often breaks down when he has to continue such patterns over an extended period of time.

Cross Overs showed the highest inter-rater concordance of the three items (98%). All had roughly similar validity ratings. In the final decision, Cross Overs seemed to be the easiest to administer, to have the highest reliability and in general to be the best representative of this area. Although Repetitive Hand Foot Taps yielded inter-rater concordance of 91%, it was noted that it was sometimes difficult to count the number of coordinated hand-foot taps. Standing on One Foot, while an interesting back-up item of balance, is covered in the more powerful Gait Patterns item.

As may be seen from Appendix 2, Cross Overs originally had two parts. In addition to hand slaps for 15 seconds, the child was required to slap the left foot with the right hand and the right foot with left hand in alternation, again for 15 seconds. It was found that various examiners were having difficulty performing this latter hand-foot slap and that it was perhaps a somewhat undignified test for a physician or a nurse, although most of the children enjoyed it immensely. Analysis of the validity data on item parts revealed that the slap hands section had higher validity than the hand-foot slaps -- in fact as high as the two parts together. It was thus decided to keep the hand slaps and increase the time to 30 seconds to maximize the persistence factor.

Thus, in the final format for the Physician test, the number of two slap patterns the child can accomplish in 30 seconds provides the raw score from which scaled scores out of 4 are assigned as follows: 0 to 15 slaps obtains a score of 0, 16 to 21 slaps a score of 1, 22 to 26 slaps a score of 2, 27 to 30 slaps a score of 3, and 31 or more slaps a score of 4. This provides a roughly bell-shaped distribution of scores with approximately 40% of children obtaining a score of 2, and the bottom and top 10%, scores of 0 and 4 respectively.

Common Section

As indicated above, the common section is administered as part of the Physician screening test when that is being given, or the Educator screening test when that is being administered. In general, it contains items which are a bridge between the two screening tests. In actual fact, the authors found themselves developing two items for the areas covered by Repeat Phrases, Repeat Sentences, Match Forms, Clap Hands, and Gait Patterns -- one for the physician and one for the educator screening test. For example, the published test (Hainsworth & Siqueland) has a Repeat Words and a Repeat Sentences item (see Pool 1). In addition, on Pool 3, another language repetition item called Repeat Phrases was devised for potential use by the physician. The same situation pertained with the Match Forms item in the Visual-Perceptual-Motor modality. Two subtests called Match and Memory already existed in Pool 1. However, in searching for more suitable items for a physician, Match Forms was devised with memory and match components built into it. Likewise, in the

Body Awareness and Control area, the Pool 1 items Clap Hands and Hand Patterns had been established. The need for a test in this area which the physician could use led to devising a new Clap Hands, which was essentially a combination of salient factors in the two previous items.

Rather than have these areas covered twice in two forms, it seemed ideal to pick the better item or select the best parts from each. This was especially true as the authors felt that some examiners would wish to give both screening tests, and consolidating these common items reduced the battery testing time. Further, since these items were tapping very crucial functions, consolidating or picking the best items allowed for very solid measurements in each area.

Cl. Repeat Phrases. As indicated above, this item was derived from Repeat Phrases of Pool 3 and Repeat Words of Pool 1. It taps a simple input-output language mechanism since it involves listening to nonsense words or phrases and re-auditorizing or saying them back to the examiner.

From Tables 3 and 5, it may be seen that Repeat Words has inter-rater concordance of 97%, while Repeat Phrases a concordance of 90%. The validity analysis data indicates that Repeat Words has excellent ratings for the prediction of academic achievement, the neurological index, and the combined factor and a good prediction of achievement in the Public School population. Repeat Phrases has good to excellent ratings on the Collaborative Study criterion variables and a good rating of prediction of school achievement in the Public School population.

Reauditorization tests have been utilized in informal ways by physicians who often include such phrases as Methodist Episcopal or other tricky tongue twisters in their testing. In general, such evaluation has been unsystematic and usually has involved giving only one or two phrases. Certain language therapists have also used this kind of technique. In addition to Meeting Street School, repetition of language material is utilized on one group screening test of language disabilities (Slingerland). Meeting Street School has been working on this kind of item for several years and has accumulated considerable experience with the repetition of language at several levels. The child can be asked to repeat nonsense words. In this case, acute listening and repeating back of unfamiliar combinations of syllables is being tested. Many clinicians have been aware that, even in familiar words some children get the syllables mixed up, i. e. aminal for animal. The third level includes the tongue twister such as Methodist-Episcopal or Thistles and Thorny Bushes on the Pool 3 item. Further, it is possible to test with longer sentences. This method has been used extensively in the Stanford-Binet for many years (Terman and Merrill), although it has been dropped in recent editions as being a poor measure of "intelligence". Some personnel working in the area of linguistics have suggested that one can also measure repetition of sentence material that is syntactically correct but semantically meaningless (i. e. crocodiles sweep pencils) or material that is semantically meaningful but syntactically without proper order (i. e. school go I to).

Except for the latter two versions of longer sentence material, Meeting Street School has experimented with all these levels of language repetition, and examples of all are included in the repetition items from Pools 1 and 3. Until the item analysis data was available, the authors decided to keep various examples of all of these repetition types and levels and make the final decision of what to include on the basis of the ability to predict school achievement and neurological involvement.

One traditional difficulty with repetition items has been that the administration is subject to the variable accent or speech patterns of the examiner. Further, the examiner must also judge the child's reproduction for accuracy. In order to make the presentation of the item as standard as possible, diacritical marks for pronunciation have been utilized and the instructions indicate that the examiner should speak directly to the child in a distinct manner and at face level, and evaluate the child's reproduction carefully from this same position. The above concordance figures suggest that, if the item is administered and scored carefully, it has good reliability.

From the validity analysis of the item parts of these Pool 1 and 3 items, the following were kept: 1) Ah-man-ee; 2) Laudy tu dum; 3) Above and below; 4) Behind and ahead; 5) Kaka kadaket;

6) Tum titty um tum tum; 7) Quack Duck Quack; 8) Transcontinental. The words and phrases are scored 1 or 0 points, for a possible total of 8. These 8 items provided a range of scores for both five and seven year olds and showed the highest relationships to school achievement and neurological involvement factors. It is interesting to note that the final selection includes five nonsense words or phrases (ah-man-ee, Laudy tu dum, Kaka kadaket, Tum titty um tum tum and Transcontinental which is a nonsense word for young children because it is unfamiliar), and three phrases which are phonologically difficult to repeat (Above and Below, Behind and Ahead, Quack Duck Quack). The authors feel thatas well as showing better predictive validity, these nonsense words and phonologically difficult phrases are clinically superior to tongue twisters (Sea Shells, Aluminum Limited, Thistles and Thorny Bushes) and to the common words (Wigwam, Elephant, Spaghetti). The nonsense words really measure new learning, that is basic skills in the sensory-motor mechanism; the child cannot rely on semantic or linguistic cues to help him. The three phrases appear to be good because there are so many phonological traps for the child; the example Above and Below is a classic example since children with reauditorization difficulties say belove and alow, etc.

C2. Repeat Sentences. Sentences were used both in the Pool 1 Repeat Sentences and in the Pool 3 Repeat Phrases.

The inter-rater concordance for Repeat Sentences is 97% and for Repeat Phrases is 90%. The validity analysis shows that Repeat Sentences has excellent predictive value in terms of both school achievement and neurological involvement and the combined factor, and that Repeat Phrases has good to excellent rating in these same areas. In general it was felt that the validity predictions of the sentences from the Pool 1 item were superior to the sentences in the Pool 3 item, but certainly most sentences in this area show good validity prediction.

Validity analysis of the item parts led to the selection of the following three sentences:

1) Please pass the meat and peas (6 words)

2 In the first inning, Tom hit the ball (8 words)

3) Joan and Jane had a chocolate sundae after the movie yesterday (11 words).

Two of these sentences were taken directly from the Pool 1 Repeat Sentences item and, in addition, another sentence of the same variety which had not been used in Pool 1 or 3 items was added. This is an item which had been tried out in previous Meeting Street School test development efforts. It provided the necessary range of scores as it was a transition from the easy six word first sentence to the much more difficult last sentence.

The number of words repeated in their correct position in the sentence are summed for the three sentences and a scaled score transformation (0 to 8) utilized: 0-4 words repeated correctly is given a scaled score of 0, 5-9 a score of 1, 10-12 a score of 2, 13-15 a score of 3, 16-20 a score of 4, 21-22 a score of 5, 23 a score of 6, 24 a score of 7, and 25 a score of 8.

C3. Match Forms. As indicated above, Match Forms involves both matching and memory elements. The child is first asked to pick out a form by memory from three alternates presented on a card. If the child fails, he is asked to find the form by direct visual matching when the stimulus is put next to the 3 or 4 alternatives. This item is found in Pool 3 and is very similar to the two items in Pool 1, Match and Memory. All of these items measure Visual-Perceptual-Motor input skills.

As may be seen from Tables 3 and 5, Match Forms has inter-rater concordance of 100% while Match and Memory in Pool 1 have an inter-rater concordance of 99-100%. The child either points to the correct form or he doesn't, and only administrative errors make for inter-rater differences. In relationship to the validity criteria, Match Forms on Pool 3 shows good relationship to neurological involvement and to the combined achievement-neurological factor, and moderate prediction of school achievement in both samples. The strength of prediction to validity criteria for the Pool 1 Memory item is excellent and for Match is good. These tests may actually be slightly superior items to Match Forms which was chosen. The reasoning of the authors was that Match Forms showed sufficient validity to contribute considerable strength to a screening test and that it was in a form that would be easy for the physician as well as the educator to use. It utilizes much fewer materials than the Match and Memory items. Further, Match Forms uses the same materials as Find Forms and Visual Integration; this economy, efficiency and unity were felt to justify the choice.

Visual matching and memory tests have been used in various forms on educational tests for many years. In most tests of reading diagnosis there is some visual matching, and special education tests (Slingerland, Frostig et al) have also utilized such material. The essential work of Meeting Street School during the grant year was finding valid stimuli to be matched and putting the item in a simple and useful format that could be employed by both physicians and educators.

The final format chosen for the common section of the Physician-Educator screening test includes one example and four parts. These five parts were selected from the seven which appeared in the Match Forms item of Pool 3 because they provided a range of scores for four to seven year old children and showed the strongest relationships to the validity criteria:

Pie (example)

1. Chair (score 2 or 1)

2. Long-Tailed Animal (score 2 or 1)

3. Clock (score 2 or 1)

4. Figure (score 2 or 1)

Two points are given for each item part the child identified from memory, 1 if he has to use visual matching, and 0 if he cannot even match. The total possible for four items is 8.

C4. Clap Hands. This item was derived from a melding of Clap Hands and Hand Patterns in Pool 1. It measures sensory integration to gross motor patterning in the Body Awareness and Control modality. It is a cross modality item for it involves a child watching the examiner perform certain clapping patterns in front, behind, above, below and diagonally to the examiner's body, and then performing the same motor movements himself.

Reference to Table 3 indicates that the inter-rater concordance for Clap Hands is 100% and for Hand Patterns is 96%. The relationship to achievement and neurological criteria is good to excellent for Clap Hands and moderate to good for Hand Patterns.

Since Clap Hands and Hand Patterns both measure the child's ability to see, remember and reproduce unlearned, sequential patterns in appropriate special relationship to his own body, it was not felt that both were necessary for a screening test. After the item and item part validity data was available, it was decided that the Clap Hands format was probably the more powerful way of measuring this area. However, from field testing and more particularly through the clinical experience, the authors felt that the original Clap Hands item could be improved. Therefore, certain changes were made in the item before the normative samples were obtained. Because the authors changed the item without prior use of data, a longer item was included in the test norming battery than was finally included:

1. Slap, clap, clap
2. Front, front, back
3. Up, down, down, left, right
4. Left shoulder, right hip, right shoulder, left hip (Diagonal Claps)

It may be seen that of these four sections only front-front-back remains from the original Hand Clap item of Pool 1.

Clinical analysis of this new Hand Clap item by the authors indicated that what one is really measuring is the ability of the child to reproduce the claps in their spatial positions (i. e. front vs. back, up vs. down, up-left vs. down-right, etc.) and in their correct number (clapping front, back is very different from clapping front, front, back since the child must remember the number in addition to remembering the position). Slap, clap, clap was added on this principle and because the simple up, down clap which proceeded front-front-back in Pool 1 was really too easy for the four and five year olds and so was not adding power to the item. After front-front-back, up-down-down-left-right was felt to be a more demanding task than up-up-down-back. Finally, diagonal claps was added to get at the crossing of the midline, as well as more complex spatial positions.

The inclusion of these four parts into the final test norming battery allowed a special item analysis following the collection of normative data. This was conducted in the same manner as the previous item analysis. Slap-clap-clap was passed by 25% of the children under five and so was considered a good basal item. Up-down-down-left-right and diagonal claps were of approximately equal difficulty since approximately 20% of the children above 7-0 passed these parts. The special validity analysis indicated that diagonal claps related slightly better to the achievement criterion than up-down-down-left-right; however, the major reason for selecting diagonal claps rather than up-down-down-left-right was that this latter item was confusing for some children. Further, diagonal claps had the advantage of not being only a midline test but involved crossing sides of the body, which is a known difficulty for psychoneurologically inefficient children.

The final form of the test which then appeared in the common Body Awareness and Control section was slap-clap-clap (scored number of attempts in 2), front-front-back (scored number of attempts in 3), and diagonal claps (scored number attempts in 2). This provided a total possible score of 7.

C5. Gait Patterns (Pool 1 item). Gait Patterns is the only item in the item pools measuring gross motor patterning of primarily learned skills. This item samples the child's effectiveness in learned unilateral and bilateral body movements, without the visual cues as in Clap Hands or the auditory cues as in Follow Directions I.

The observation of children's gait has been a basic part of the pediatric neurological evaluation for a long time. For a number of years, Meeting Street School has attempted to measure the functional aspects of gait patterns. At first, efforts were made to assess the smoothness of the basic gait patterns of hopping, walking, running, skipping and the ability of the child to easily change from one pattern to another. However, these early attempts involved questionable judgements of what was a smooth gait or a smooth change of gait and such measures were shown to have low inter-rater concordance. Thus, prior to the year of the grant, Meeting Street had already established that to measure gait patterns in an objective way, one either had to count the number of times a child could sustain a pattern like hopping, or use an all-or-none criterion such as that the child can do a skipping pattern or he cannot. It was known that items scored in this way would have high inter-rater concordance. To provide an upward extension for seven year olds, the item dance (or double hops on one foot, followed by double hops on the other foot, etc.) was invented to provide more ceiling for the older children.

Because of this extensive work prior to the grant and because the item part validities for Gait Patterns were good in the Collaborative and Public School populations, this item was included directly in its Pool 1 format into the normative sample:

1. Hop 5 times on each foot (1 point for doing so on each foot)

2. Skip (2 points for skipping, 1 for lame duck shipping)

3. Dance (2 for correct on 1st trial, 1 for correct after 2nd demonstration)

The 0-6 range of scores so derived is slightly less than the majority of items but is probably commensurate with its predictive power in the screening test.

Educator Section

In selecting tests for the Educator section, the authors drew heavily on the previously published work (Hainsworth & Siqueland) aimed at assisting special educators to identify children with learning disabilities early in their school careers. Of the six tests in this section, three were included as is from this publication (Counting, Sequencing and Copy), two were slightly modified during field testing (Follow Directions I and Follow Directions II), and only one item was new (Visual Integration).

Because so much work had been done prior to the grant and the authors' efforts were on developing items for Pool 3 and testing out Pools 3 and 2, the educator items were taken somewhat for granted. This led to a tactical error on the researchers' part, as the final Educator Screening test was normed without adequate representation from the items in Pool 1. After the normative procedures were well into effect and several dozens of children had been evaluated, it was realized that the Physician-Educator battery would be missing the integrative language skills involved in Sequencing and the integrative visual-perceptual-motor skills of Copy.

Since these two items had been previously administered to a representative sample of 100 children at the same one-half age levels (Hainsworth & Siqueland), it was decided to add expected values for each child on these two items into the total Educator Screening test score for the purpose of providing normative tables. Utilizing the scores for the children on the other nine items in the Educator section and the slope lines for the Sequencing and Copy items from the previous work, the cut-off points between the six scores on Sequencing (.5, 1.5, 2.5, 3.5, 4.5 and 5.5) and the 8 scores on Copy were derived using a regression formula. In this way it was determined that a score of 0 to 25 on the Educator total would be equivalent to a score of 0 on Sequencing, 26-30 = 1, 31-34 = 2, 35-39 = 3, 40-43 = 4, 44-48 = 5, and 49+ - 6. Likewise, scores for the Copy subtest were derived as follows: 0-24 = 0, 25-30 = 1, 31-33 = 2, 34-36 = 3, 37-39 = 4, 40-42 = 5, 43-45 = 6, 46-48 = 7, and 49+ = 8. These estimated scores from 0 to 6 for Sequencing and 0 to 8 for Copy were added to the scores for the other nine Educator items in a way that fully reflected this score. While this procedure does not allow further validity analysis of these two items, it does allow scores for the two items to be added into the total Educator score for the purposes of deriving age norms.

E1. Counting. This item was derived from Counting of Pool 1. Counting Fingers of Pool 2 is a similar task but one which also requires making a translation of the number to the finger involved. Counting samples integrative functions in the Language area while Counting Fingers involves cross modality integration.

The inter-rater concordance for Counting was 97% and reference to Table 3 indicates that it has an excellent rating of prediction of all validity criteria. Counting Fingers also has excellent inter-rater concordance (99%) and has also excellent predictive validity in the Collaborative Study. The prediction of school achievement in the Public School sample was good. Since the Counting item had one of the highest overall validity ratings of any of the items in the three pools and is an easy item to administer, it was obviously a must for inclusion in the Educator test. It was decided to sacrifice Counting Fingers, even though it showed almost as high a validity rating, because it seemed to be measuring some of the same skills and was a much more complicated item to give (since it involved getting the set across to the child of his fingers being counted and then touching certain fingers for him to number, both with the child watching and with his fingers held behind a screen.)

Almost all of the pilot work and field testing for this item were done prior to the year of the grant. This previous field testing involved determining that the child should be asked to say numbers forward from 1 to 10 and then backwards from 10 to 1, that it was worthwile timing the child, and that the cut-off point for an easy versus a more labored response (in which the child might have to continually reserialize the numbers) was approximately seven seconds. In addition, field testing indicated that, to provide enough ceiling for seven year olds, it was wise to add counting to ten by 2's and, to provide a proper basal, the young child could be asked to count up to 5. In the Pool 1 version, the child was actually asked to count five line-drawn blocks on a card which was also used for the Block Tapping item deleted from the present battery because of low validity. No other changes were made and the item was normed as follows to give a total possible score of 8:

Forwards 1-10: 3 for 1-10 in under seven seconds,
2 for 1-10 in seven or more seconds,
1 for 1-5;

Backwards 10-1: 3 for 10-1 in under seven seconds,
2 for 10-1 in seven seconds or more,
1 for 5-1;

Count to 10 by 2's: 2 for correct without help,
1 for correct following the examiner saying 2,4 .

E2. Sequencing. As indicated above, the score for this integrative language item had to be estimated on the basis of the Educator section and that this item was not included in the normative battery but is reflected in the table of norms provided in the results section of this report.

From Table 3 it may be seen that Sequencing has excellent inter-rater concordance (99%) and that its relationship to all validity criterion is in the excellent range.

The pilot work for this item was also done prior to the year of the grant and was based on the growing awareness in the field that the breakdown of the psychoneurologically inefficient child in sequencing information in various modalities is one of the prime characteristics of his disability. A number of time concept, quantity, and spatial sequence tests have been developed by Meeting Street School. The sequencing item is based on the time concept items listed below:

1. Breakfast, lunch................. (supper)
2. Morning, afternoon.............. (evening or night)
3. Yesterday, today................ (tomorrow)
4. Fall, Winter.................... (spring)
5. Sunday, Saturday, Friday........ (Thursday)
6. Week, day, hour................. (minute)

This test was included exactly as is in the final battery, although it probably would have been useful to have added two subparts to make the total score closer to 8 in line with the possible scores of other powerful items.

E3. Visual Integration (Known as visual discrimination in Pool 2). This is another original item devised by the authors from their clinical experience in working with psychoneurologically inefficient and learning disability children. It samples intake skills in the Visual-Perceptual-Motor modality and was renamed Visual Integration since it involves "closure" on abstract line drawings. Another original item was designed in this same area -- Ink Blots found in Pool 3. This requires the child to give one response to each of 18 ink blots, each on a small 3x4 card shown in the upright position only. Both of these new tests were developed because of the authors' clinical experience with the Ink Blot Test (Rorschach) where children with learning disabilities show characteristic visual-perceptual anomalies.

The inter-rater concordance for Visual Integration is 98%, but the validity ratings from the Collaborative Study sample were only moderate for achievement and questionable for neurological involvement and the combined factor. The prediction of school achievement in the Public School population was somewhat better and fell in the good range. The validity analysis of Ink Blots showed that this item fell in the good range in prediction of achievement, neurological involvement and the combined factor in the Collaborative Study population. It would appear then that Ink Blots is a superior item to Visual Integration. The decision to keep the Visual Integration item and discard Ink Blots for this battery was based on practical considerations. The cost of reproducing the ink blots by a photographic process was prohibitive, while the Visual Integration item only necessitated the wall chart used in administering Find Forms and Match Forms. Further, the authors felt that Visual Integration had clinical validity for children with severe visual-perceptual deficits.

Prior to the collecting of data from the Collaborative and Public School populations on item validity, considerable field testing on the Visual Integration item was carried out by the authors in their clinical practice. Field testing by the research assistant indicated that the 11 item parts being considered produced a wide range of scores for the four and five year old as well as for the seven year old child. It was thus decided to keep the 11 parts and discard some after item analysis data was studied. Following item-part analysis, it was decided to keep six of the 11 forms and to add one new figure for the normative run. The six figures kept showed a reasonable range of scores for four and seven year old children and generally had the highest validity ratings of the 11 parts. The seventh form (sun) was added to provide a more continuous range of difficulty of the items over the three year age span.

The final form of the test in the Educator Section is as follows:

1) House
2) Chair
3) Clock, watch
4) Sun, compass points
5) Figure in motion
6) Pie, cake, clock
7) Animal

Each of these parts is given 1 point for a correct response, for a possible total of 7.

E4. Follow Directions II (from Pool 1). This Visual-Perceptual-Motor modality item measures the child's understanding of spatial and directional concepts when drawing on a piece of paper. It is a unique item in our item pools.

From Table 3 it may be seen that the inter-rater concordance of this item is 95% and that it has excellent predictive validity of the neurological and combined achievement-neurological criteria, good prediction of school achievement in the Collaborative Study and excellent prediction of school achievement in the Public School population. Because of its uniqueness and its good to excellent validity ratings, this item was included in the final Educator screening battery.

The pilot work and field testing for this item was done primarily prior to the grant. Various formats for giving the item have been tried. In the published Pool 1 data (Hainsworth & Siqueland), the child is given a piece of 5x8 paper with a picture of an automobile facing the child from the center of the page. The child then performs various drawing operations in relationship to the spatial coordinates of this car and of the paper.

Despite the rather intensive field testing of the item prior to the beginning of the grant, it was found to be somewhat skimpy in measurement at the lower age levels. The majority of the children to age six could only pass the first item part and half-score units had to be used to allow the next two item parts to provide the range for the younger children necessary to have predictive power. It was thus decided that the lower end of the scale needed further work and at this point the authors decided to rework the item entirely.

In order to simplify the materials used so that a printed worksheet with the car on it would not be necessary, the research assistant and co-directors began exploring what could be done with just a piece of blank paper (on which the examiner draws a box) and a pencil and verbal commands from the examiner. It was decided to add one more item part to make a possible score of 7. Field and clinical testing resulted in the selection of the following item parts:

1. Draw an X inside the box.
2. Draw a ball above the box.
3. Draw a line from the bottom of the page to the box.
4. Draw a line from the right-hand side of the page to the box.
5. Draw an X in the upper left-hand corner of the page.
6. Draw a smaller x between this one (point to the other X) and the box and put a line under it.
7. Turn your page over (pause), draw an X, put a circle beside the X, and then draw a square around both.

Of these seven final items, three appear in the original Pool 2 item, two are extremely similar, and two new items (numbers 1 and 6) were added. Number 1, draw an X inside the box, was included to provide basal for the test, and number 6 was added to give more continuity of scores at the upper level. The authors felt that the above changes were consistent with the principles underlying the item. Future cross-validity studies will check these decisions.

E5. Copy (from Pool 1). As discussed above, this item was not included in the current normative sample, but estimated scores were added into the Educator screening test total. This type of item measures visual-motor skill in the Visual-Perceptual-Motor modality.

Due to the Bender Visual Motor Gestalt Test (Bender), the drawing of geometric forms has been a standard measure of this area for many years. In fact, for many years it has been almost the only test available for assessing not only visual-perceptual-motor function but, in many cases, has been used as a global index of psychoneurological inefficiency or "organic" conditions. The present authors feel that copying forms does not spot many visual-motor problems, let alone global psychoneurological or "organic" difficulties. However, it is a powerful item which adds to the present screening tests.

It may be seen from Table 3 that Copy has 93% inter-rater concordance and excellent ratings in all the criterion variables of the Collaborative Study, although it achieved only a moderate rating based on its correlation with achievement in the Public School population.

All of the pilot work and field testing of this item were done prior to the grant, including the development of scoring examples (Hainsworth & Siqueland). The Meeting Street School version of this item not only includes copying geometric forms (circle, square, diamond, triangle), but also copying a word (may). Its scoring reflects not only the accuracy of the reproduction of the forms, but also the spacing between forms or letters.

The final format of the item was kept as in Pool 3 and includes the following:

1) Copy circle, square
2) Copy diamond, triangle
3) Copy the word May

A total score of 8 is derived from 1 point for each of the four geometric forms, 1 point for each correct juxtaposition of circle-square and diamond-triangle, and 1 or 2 points for copying the word May.

E6. Follow Directions I. This item comes from Pool 1 and represents the Body Awareness and Control modality. It assesses the child's ability to comprehend and retain verbal directions involving spatial concepts and translate them into movements of his body in space. This is a unique item, being the only one measuring this verbal to gross motor cross modality translation.

From Table 3, it may be seen that Follow Directions I had 96% inter-rater concordance. Its relationship to all validity criteria was in the excellent range except for the prediction of school achievement in the Public School population which was good.

The pilot work for this item was essentially done before the grant period began. In very early versions, this item was written in the fairly standard form used by pediatric neurologists. It was a four part item in which the child was asked to raise his right hand, left foot, left hand and right foot. Although this appears to be a four part item, it is actually only a one part item; once the child has been asked to locate his right hand, his responses to the next three items are variously influenced by his first action. The intelligent child usually produces consistent responses, whether they are all right or all wrong. The unintelligent child is usually less consistent. In a recent test (Ozer), an attempt has been made to give points to the child who is consistent, even though he is wrong. The present authors do not believe that this is a valid approach. Further, the item appears to have much more potentiality than has been tapped, since understanding right and left is an isolated skill. Of greater concern is the child's complete awareness of the spatial relationship his body and sides have to the coordinates of space. Other attempts have been made to increase the power of the item by asking the child to touch his right knee with his left hand for example. While such additions certainly provide more range, their reliance is still on the right-left dimension primarily.

The item which appears in Pool 1 does sample knowledge of right-left, but also the notions of above the body and behind, forward and backward, turning and facing away, between, and following some numerical concepts involved in numbers of steps forward or backward. Item analysis of the parts indicated that each contributed significant power to the predictive capacity of the item. The desire to have the item be scored out of more than six points and the fact that there seemed to be slight discontinuity in the middle of the item, led to the decision to add one more subpart.

The item as it finally appears in the Educator screening test is as follows:

1. Take two steps forward and one step backwards.
2. Turn to your right.

3. Take 3 steps toward me and then turn and face away from me.
4. Touch your right ear with your left hand.
5. Turn right, take 2 steps backwards, and then turn left.
6. Put this pencil (hand to the child) above your head and then behind you.
7. Put the pencil between us and then nearer to you.

One point is given for each direction followed exactly, for a possible total of 7.

Preparing Normative Tables

The 19 items discussed above were assembled into two batteries (See Appendix Four) and administered to 681 children in nine schools in Providence and East Providence, Rhode Island. Table 6 shows the total number of children tested in each of the six half-year age levels from 4-9 through 7-5, the number selected for the Normative sample, and the number of Disadvantaged and Hard Core Disadvantaged.

Table 6: Characteristics of the Normative Disadvantaged and Hard Core Samples

	4^{9}-4^{11}	5^{0}-5^{5}	5^{6}-5^{11}	6^{0}-6^{5}	6^{6}-6^{11}	7^{0}-7^{5}	Total
Total Tested	40	94	136	135	148	128	681
East Providence	25	65	98	100	92	85	465
Providence	15	29	38	35	56	43	216
Normative Sample	34	70	90	90	100	80	464
Disadvantaged Group	20	34	36	48	61	44	243
East Providence	6	10	16	28	28	23	111
Providence	14	24	20	20	33	21	132
Hard Core (Disadvantaged)	12	9	7	13	25	17	83

The Normative sample for each half-year was derived from the larger number of children tested in that age group. It was made representative of the United States socio-economic distribution through using the Census figures for fathers' occupations. Within each half-year age group, an equal number of boys and girls was selected in both the white collar and blue collar groups. Further, an equal representation from each of the six months in each age group was established: for example, equal numbers of 7-0, 7-1, 7-2, 7-3, 7-4 and 7-5 children in the 7-0 to 7-5 age group. Finally, the numbers of children in each of the nine socio-economic categories fell within one or two of the number sought; the total percentages were exact for the following category combinations: 1 and 2, 3 and 4, 5, 6, 7 and 8, 9.

Table 7: Preliminary Tables of Norms for the Physician Screening Test

NORMATIVE GROUP

Age Groups

Percentile Points	4^{9}-4^{11} (n=34)	5^{0}-5^{5} (n=70)	5^{6}-5^{11} (n=90)	6^{0}-6^{5} (n=90)	6^{6}-6^{11} (n=100)	7^{0}-7^{5} (n=80)
90	47-52	54	63	67	71	74
80	45	48-50	57	64	69	69-70
70	41-42	46	54	62	67	67-68
60	37-38	42	51	58	65	64-65
50	34-35	40	49	56	62	62
40	30-31	37	47	54	60	59-60
30	27-28	34	45	50	57-58	53-55
20	22	28-31	41-42	47	54	50
10	20-21	23-24	34-36	43-44	49-50	46

DISADVANTAGED GROUP

90	41-44	53	57-59	66	69	69-73
75	35-37	43	50	57-58	65	65-66
50	27-28	38-39	45	52	59	59
25	21	32	32-34	46 -47	49-50	49-50
10	18-19 (n=20)	23-24 (n=34)	25-28 (n=36)	38 (n=48)	42 (n=61)	42 (n=44)

Table 8: Preliminary Tables of Norms for the Educator Screening Test

NORMATIVE GROUP

Age Groups

Percentile Points	4^{9}-4^{11} (n=34)	5^{0}-5^{5} (n=70)	5^{6}-5^{11} (n=90)	6^{0}-6^{5} (n=90)	6^{6}-6^{11} (n=100)	7^{0}-7^{5} (n=80)
90	35-37	40-41	53-54	63	70	69-71
80	29-32	36-37	47-48	59-61	65-66	66-67
70	25-26	34	43-44	56	64	62-63
60	22-24	30-31	40	50-52	62	59
50	20-22	27	35-36	48-49	58	55
40	17-18	26	33	43-44	56	52-53
30	16	23	30-31	40	51-52	46
20	12-14	20-21	27	34	48	41
10	12	14-15	24	30-31	37-39	36

DISADVANTAGED GROUP

Percentile Points	4^{9}-4^{11}	5^{0}-5^{5}	5^{6}-5^{11}	6^{0}-6^{5}	6^{6}-6^{11}	7^{0}-7^{5}
90	24-29	39-41	46-49	57	65	64-67
75	20-22	35	38-42	49-50	62	56-57
50	16	26	30-31	40-41	53	48-49
25	12	22	24-25	32-33	36-38	39-40
10	12	10-12	19-20	24	27-28	29-30
	(n=20)	(n=34)	(n=36)	(n=48)	(n=61)	(n=44)

Table 9: Preliminary Tables of Norms for the Total Screening Test

NORMATIVE GROUP

Age Groups

Percentile Points	4^9-4^{11} (n=34)	5^0-5^5 (n=70)	5^6-5^{11} (n-90)	6^0-6^5 (n=90)	6^6-6^{11} (n=100)	7^0-7^5 (n=80)
90	64-66	70	88	100	108	110
80	54-55	64-65	81-82	94-96	102-103	104
70	51-52	59	76	90-91	99-100	100-101
60	46-47	54	69-70	84-86	97-98	97
50	39-44	49-50	64-65	79-80	93	93
40	35-36	47	62	74-75	90	85-86
30	32-33	42-43	59	70-71	85-86	82
20	28	34-38	53-54	64-65	79-81	68-70
10	23-24	28-30	43-44	57-59	68-70	63-64

DISADVANTAGED GROUP

90	51-55	65-70	82-84	96	105	102-110
75	39-44	57	68-70	81-83	97-98	94
50	32	47-48	56-57	71-72	86	82-83
25	25-28	43	41-43	62-63	65-67	67-68
10	22 (n=20)	28-30 (n=34)	34-39 (n=36)	51 (n=48)	55 (n=61)	55-59 (n=44)

In order to pick such an exact representative sample with the children tested in each half-year age level, the normative groups were restricted to 80 children in the 7-0 to 7-5 age level, 100 in 6-6 to 6-11, 90 in 6-0 to 6-5, 90 in 5-6 to 5-11, 70 in 5-0 to 5-5. It was deemed better to match the percentages exactly for socioeconomic levels than have equal numbers in the normative table for each half-year age range. Because of the difficulty in obtaining children in the 4-6 to 4-11 age group, only 34 children from the ages 4-9 through 4-11 are included.

The sample of Disadvantaged children was assembled at each half-year age level by taking all the children tested whose fathers' occupations fell in the operative, laborer, and unemployed-unclassified socioeconomic levels in Providence and East Providence (Census categories 6, 8 and 9; category 7, service workers like policemen, was excluded because it appeared qualitatively different from categories 6, 8 and 9).

In order to prepare preliminary tables of norms for the general and disadvantaged populations, the scores for Physician, Educator and Total Screening tests were listed from lowest to highest for the children in the Normative and Disadvantaged groups at each half-year age level. In the Normative group, ten decile points separating the group into tenths were determined from the above listings. The top half of Tables 7, 8 and 9 reports the test scores corresponding to each decile point in this distribution of raw scores. The bottom half of each table lists the scores corresponding to the 10th, 25, 50th, 75th and 90th percentiles of test performance for the Disadvantaged group.

To use Tables 7, 8, or 9, one would take a child's score on a screening test, find the appropriate age group from 4-9 to 7-5, and then determine in which decile (or quartile) the child's score fell. For example, if one had tested a 6-3 aged child with the Physician test and he scored 52, a perusal of Table 7 (column 6-0 to 6-5) indicates that a score of 48 falls between the 30th and 40th percentile in the Normative population. Likewise, his score can be compared with the group of Disadvantaged at his age level by looking at the bottom of the page in the same column.

It may be seen that there are some discontinuities in the Tables: such as the low end of the distribution of children 7-0 to 7-5 in the Normative Sample scoring the same as or slightly lower than children 6-6 to 6-11. This appears due to an unexpectedly large number of inefficient children in this age range, which is confirmed by the fact that the IQ scores for the 7-0 to 7-5 group are also lower than for the 6-6 to 6-11 group (103.5 versus 106.5). Final tables of norms will be prepared at a later date to smooth out these sample inconsistencies by taking into account means and standard deviations and the general shape of the curve of percent of achievement at various age levels.

Screening Test Reliability and Validity

The correlations between the Screening tests and achievement test scores is reported in the following section on Factor Inter-Relationships. More achievement scores, and on a larger percentage of these children, will be available for follow-up in later years. In addition, group analysis of the Screening test scores in low and high achieving groups will give information on the ability of the Screening tests to predict inadequate achievement due to psychoneurological inefficiency.

The relationship of the Screening test to the other major validity criterion of neurological involvement was studied in 19 children with known neurological impairment. The t test value between the Total Screening test scores of these children and their counterparts of the same age and socioeconomic level was 6.32, which is significant beyond the .001 level. It is hoped that further validity studies utilizing the Collaborative Study population will be possible.

Screening test reliability was .89 and .93 (n=15 and 15) for inter-rater comparisons using battery 1 and 2 (corresponding to Physician and Educators screening tests). The test-retest scores for the same batteries were .76 and .79 (n=30 and 32). These scores are felt to be good considering the fact that the test-retest was three to five weeks apart, and that non-professional testers were involved in these reliability studies. The research assistant had originally trained fifteen volunteers to administer the Screening tests in the schools, and the above figures were obtained by a random group of these testers. This indicates that the developed tests have considerable objectivity for a wide range of examiners, trained in a short period (one to three half-days for these non-professionals).

FACTOR INTER-RELATIONSHIPS

Relationship of Screening Tests to School Achievement (Validity)

Within the scope of a one year test development project, only tentative validity studies of short term predictions can be made. To assess the validity potential of the Physician, Educator and Total screening tests, the readiness scores of kindergarten children and the achievement scores of first graders tested were utilized. From Table 10, it is evident that all three screening test scores, the Physician and the Educator and the Total, correlate well with the validity factors of school readiness and achievement--thus indicating that each of the developed tests is a valid instrument. Correlations with readiness scores of kindergarten children are somewhat higher than with school achievement scores of first graders. This is due, in part, to the fact that the Screening tests and the Metropolitan Readiness test are more similar in functions tested.

The scores on the Total Screening Test were also broken down by information processing modality. From Table 2, it was seen that scores for Body Awareness and Control were derived from four items, for Visual-Perceptual-Motor from eight items, and for Language from seven items. Table 11 presents the investigation of the relationship of these information processing skills to school readiness and achievement. The correlations between Body Awareness and Control and readiness or achievement in Normative Sample may be seen to be .54 for kindergarten and .43 for grade one; for Visual-Perceptual-Motor, .64 for kindergarten and .47 for grade one; and for Language, .65 for kindergarten and .56 for grade one. These correlations compare favorably with those between the Physician and Educator and Total tests and readiness or achievement. This suggests that, in future work with the Screening tests, it might be profitable to provide normative tables for these three modalities.

The above correlations indicate that the Language modality shows the most stable predictions of school achievement since it has parallel results between kindergarten and first grade. Both the Language and Visual-Perceptual-Motor modalities manifest strong relationships to measures of academic readiness or success. The correlations with Body Awareness and Control are slightly lower. However, the range of scores in the Body Awareness and Control modality is about half that of the ranges in the Visual-Perceptual-Motor and Language modalities and this restriction in range partially accounts

Table 10: Relation of Screening Test Scores to Achievement, Socioeconomic Level, and IQ

			School Readiness or Achievement	Socioeconomic Level	P. M. A. Group IQ
Kindergarten	Physician	Normative	.64 (n=151)	.-25 (n=272)	No Data
		Disadvantaged	.58 (n=56)	---	
		Hard Core	.75 (n=7)	---	
	Educator	Normative	.69 (n=151)	.-28 (n=272)	No Data
		Disadvantaged	.60 (n=56)	---	
		Hard Core	.89 (n=7)	---	
	Total	Normative	.71 (n=151)	.-27 (n=272)	No Data
		Disadvantaged	.64 (n=56)	---	
		Hard Core	.92 (n=7)	---	
First Grade	Physician	Normative	.50 (n=134)	.-25 (n=192)	.45 (n=168)
		Disadvantaged	.61 (n=53)	---	.60 (n=81)
		Hard Core	No Data	---	.46 (n=23)
	Educator	Normative	.56 (n=134)	.-31 (n=192)	.53 (n=168)
		Disadvantaged	.70 (n=53)	---	.64 (n=81)
		Hard Core	No Data	---	.39 (n=23)
	Total	Normative	.56 (n=134)	.-29 (n=192)	.52 (n=168)
		Disadvantaged	.71 (n=53)	---	.66 (n-81)
		Hard Core	No Data	---	.47 (n=23)

Table 11: Relation of Information Processing Skills to Achievement, Socioeconomic Level and IQ

			School Readiness or Achievement	Socioeconomic Level	P.M.A. Group IQ
Kindergarten	Body Awareness and Control	Normative	.54 (n=151)	.-13 (n=272)	No Data
		Disadvantaged	.46 (n=56)	---	
		Hard Core	.72 (n=7)	---	
	Visual-Perceptual-Motor	Normative	.64 (n=151)	.-22 (n=272)	No Data
		Disadvantaged	.52 (n=56)	---	
		Hard Core	.96 (n=7)	---	
	Language	Normative	.65 (n=151)	.-33 (n=272)	No Data
		Disadvantaged	.63 (n=56)	---	
		Hard Core	.69 (n=7)	---	
First Grade	Body Awareness and Control	Normative	.43 (n=134)	.-15 (n=192)	.38 (n=168)
		Disadvantaged	.45 (n=53)	---	.45 (n=81)
		Hard Core	No Data	---	.23 (n=23)
	Visual-Perceptual-Motor	Normative	.47 (n=134)	.-27 (n=192)	.49 (n=168)
		Disadvantaged	.71 (n=53)	---	.62 (n=81)
		Hard Core	No Data	---	.37 (n=23)
	Language	Normative	.56 (n=134)	.-29 (n=192)	.48 (n=168)
		Disadvantaged	.64 (n=53)	---	.64 (n=81)
		Hard Core	No Data	---	.55 (n=23)

for the lower correlation co-efficients. In general, the data confirms the assumption of the developers of the present tests and curriculum that the Body Awareness and Control area is as important to the attainment of school skills as are the Visual-Perceptual-Motor and Language. However, it must be noted that the Screening Tests do not assess gross physical skills in Body Awareness and Control, but rather the total ability of the child to be aware of and move his body efficiently in space using visual and auditory cues.

Obviously, more intensive validity investigation is necessary to study the efficacy of the Screening tests. Investigations of the ability of the tests to discriminate between high and low achievers and the derivation of cut-off scores which effectively isolate low achieving as well as special types of low achieving children require further analysis. Cross-validation and long-range follow-up studies are also necessary to fully assess the predictive validity of these tests. Further, it is hoped that continued study of the Collaborative Study population will allow assessment of the ability of the Screening tests to predict the dual criteria of low school achievement accompanied by high scores on the Neurological Index. This will permit a close look at children who are failing school because of psychoneurological inefficiency or neurological involvement.

Relationship of Screening Tests to IQ

A perusal of Tables 10 and 11 indicates that Screening Test and group readiness, achievement and IQ scores all show moderately high correlations with one another. From Table 10, it may be seen that group IQ tests and the Total Screening Test correlate .52 in the grade one group, that the Total Screening Test correlates .71 with school readiness and .56 with school achievement, and IQ scores correlate .59 with school achievement (not shown).

There are two possible conclusions that can be drawn from this data. One is that since all these factors are inter-correlated, they are all measuring the same thing; thus, one test is as good as another. However, a second explanation is that the Screening Test scores and IQ, while both correlated with achievement, are predicting different facets of children's functioning which complement each other in predicting school success. This hypothesis received support in previous work (Hainsworth & Siqueland) in which the multiple correlation of Screening Test scores and IQ with achievement was significantly higher than with either of these factors alone. Such a finding indicates that the second alternative should be given consideration. Follow-up studies, multiple correlational analysis, and, perhaps, factor analytic studies would help clarify this issue.

Test Performance of Disadvantaged Children

From Tables 7 to 9 and from Tables 10 and 11, it may also be seen that the lower the socioeconomic level, the less successful the performance on all tests. This is consistent for the two Screening Tests, Total Screening Test, and the three modality subsections. The correlations between these scores and the socioeconomic level range from -.13 to -.33 for the Normative Sample. Table 12 investigates these correlational relationships by showing the significance of the difference between mean scores of the Normative, Disadvantaged and Hard Core Disadvantaged groups on the various measures. All of the reported t values between the Normative and Disadvantaged groups and between the Disadvantaged and Hard Core Disadvantaged groups are significant at the .05 level. The starred t values are significant at the .01 level. It may be seen also that the t test values between mean IQ scores for these groups are also extremely significant. Thus, while the Disadvantaged groups scores significantly lower than the Normative sample on all of these tests, it is interesting that the Hard Core Disadvantaged Group scores significantly lower than the general Disadvantaged group.

A second finding of interest comes out of the comparison of mean achievement scores for the Normative and Disadvantaged groups. Due to a paucity of achievement test results for the Hard Core (Providence) sample, the comparison only involves the suburban (East Providence) children. The mean achievement of this latter group of disadvantaged children does not differ significantly from the Normative group (mean achievement scores of 1.8 and 1.9 respectively; readiness scores of 58.6 and 62.1 respectively).

As many other writers have noted, it is evident that there are different kinds and degress of cultural deprivation and one group of disadvantaged children may be very different from another. As can be seen from Table 6, the Disadvantaged Group, used for norming purposes, includes an approximately equal number of children from inner city and small town areas. While this sample is reasonably representative of the Disadvantaged population in the Rhode Island area, no attempt was made to have it represent the nation's Disadvantaged population. Therefore, the

Table 12: Group Comparisons of the Test Performance of Normative, Disadvantaged and Hard Core Children

		Physician		Educator		Total		P. M. A. IQ	
		mean	t	mean	t	mean	t	mean	t
Kindergarten	Normative N=272	46.2		35.4		62.1		No Data	
			3.24*		3.40*		3.53*		
	Disadvantaged N=129	41.9		30.7		54.9		No Data	
			2.66*		2.06		2.45*		
	Hard Core N=36	35.7		25.6		46.1		No Data	
First Grade	Normative N=192	61.1		55.7		90.5		105.6	
			3.31*		4.76*		4.18*		2.36*
	Disadvantaged N=114	57.2		48.7		82.2		101.7	
			1.69		2.30		2.09		2.46*
	Hard Core N=46	54.0		43.2		75.3		97.0	

* Significant at the .01 level

(continued over)

Table 12: Group Comparisons of the Test Performance of Normative, Disadvantaged and Hard Core Children (continued)

		Body Awareness and Control		Visual-Perceptual-Motor		Language	
		mean	t	mean	t	mean	t
Kindergarten	Normative N=272	12.4		22.7		26.9	
			2.23		2.82*		3.63*
	Disadvantaged N=129	11.3		20.2		23.5	
			2.24		2.33		2.26
	Hard Core N=36	9.3		16.9		19.8	
First Grade	Normative N-192	16.9		35.1		38.6	
			3.24*		3.27*		4.40*
	Disadvantaged N=114	15.4		32.3		34.6	
			1.69		2.24		1.67
	Hard Core	14.1		29.2		32.0	

*Significant at the .01 level

tentative norms for the Disadvantaged (Tables 7-9) provided in this research must be checked against other groups in other parts of the country. Greater numbers of children are also needed at three of the half-year age levels.

Referring back to Table 10 and 11, the relation of Screening test performance of the Disadvantaged and Hard Core Disadvantaged groups to school readiness, achievement and IQ can be seen. In general, the Physician and Educator and Total screening tests do as good a job in predicting the school performance of Disadvantaged as of children in the Normative sample. In some cases, particularly the first grade group, the Screening tests do a considerably superior job in predicting the school achievement of the Disadvantaged group. IQ scores are also more effective in predicting the school performance of the Disadvantaged versus the Normative group; however,, not as effective as the Total Screening test.

Granted that the Disadvantaged groups score significantly lower than the Normative sample on the Screening tests, in what area(s) do the Disadvantaged primarily reveal their difference? It is a common assumption that culturally deprived children manifest deficits primarily in the cognitive and language areas and that their skills in non-language areas are much more equal to their middle class peers. This finding is not borne out in the present study. From Table 11, it may be seen that the Disadvantaged group in first grade is more handicapped by visual-perceptual-motor than language deficits, where the reverse is true in the kindergarten group. Generally the visual-perceptual-motor factor, as well as the language factor, shows a strong relationship to school achievement in both the Disadvantaged and Normative groups. The body awareness and control factor correlates somewhat less strongly but, as was discussed before, this may be due to the more restricted range of these scores. It is the authors' estimate that the relation of each of these modalities to achievement is roughly comparable. Again, the Body Awareness and Control factor measures the children's ability to be aware of, integrate and reproduce patterned movement sequences rather than measuring just gross motor strength or accuracy. The authors feel it is this awareness of body position and ability to move the body relative to spatial coordinates that are integral to the child's learning efficiency and not the overlearned or isolated motor skills.

In sum, the present results suggest that the generally inefficient school performance of culturally disadvantaged children results from a number of inter-related factors, including lowered performance on IQ tests and psychoneurological inefficiency in all three information processing modalities. Thus, the authors feel that attributing all of the school difficulties of disadvantaged children to inadequate language and conceptual functioning is misleading. Rather assessment of and educational compensatory programs for the disadvantaged must concern themselves with all areas of information processing, including body awareness and control and visual-perceptual-motor skills, as well as language and cognitive and the attitudinal factors.

THE CURRICULUM GUIDE*

The Curriculum Guide provides basic information on the development, observation, and teaching of basic language, visual-perceptual-motor, and body awareness and control skills of disadvantaged children. It is meant to be used with children screened as psychoneurologically inefficient by the Physician or Educator Screening Test developed under this same grant. The Curriculum Guide, presented in three sections, is devoted to specific analysis of how the skills within each of these three modalities, Language, Visual-Perceptual-Motor and Body Awareness and Control develop (Chapter One in each section), and how to observe and teach children to be more effective information processors (Chapter Two in each section). Such material provides the teacher with the information necessary to understand the children's overall level of functioning and a particular child's pattern of skills. This, in turn, helps her organize her general teaching program and individualize it appropriately.

The Curriculum Guide was compiled and written under the direction and editorship of the Project Co-Directors. Two physical therapists (Nancy D'Wolf, consultant, and Barbara Burpee) developed the Body Awareness and Control Section. The Visual-Perceptual-Motor section is the work of two occupational therapists (Patricia Komich, consultant and Nancy Harris). Three Language therapists helped develop the Language Section (Avonne Seideman, consultant, Mary Lu Lang and Suzanne Hallett).

DISCUSSION

The majority of the grant year was spent in developing the Physician and Educator Screening Tests and the Curriculum Guide. The authors realize that the Screening Tests and, even more, the Curriculum Guide as presented, are not in a form which makes them easily usable by the average Head Start physician or teacher. While the field test edition of the Physician and Educator Screening Tests is appended, this was utilized by examiners who had the additional benefit of being directly trained by the project research assistant. In order for any physician or teacher to use the test profitably, a kit of materials, record forms, as well as a manual of instructions which discusses test interpretation, reliability and validity is necessary. Further, the validity data herein presented is of a preliminary nature. Further study of the relationship of the tests to neurological criteria (by testing more children in the Collaborative Study) and longer term follow-up and more intensive analysis of school achievement results in the Public School population are crucial.

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* The Curriculum Guide is appended under separate cover.

This work of preparing the tests for use by a physician and teacher and adding to the validity data will be relatively easy now that the basic test development phase is complete. Meeting Street School intends to seek support for this work so that the test materials can be effectively added to the knowledge and techniques available to Head Start personnel. Further, there may be a need to provide training institutes or other follow-up service that the staff at Meeting Street School could be prepared to meet.

Secondly, investigation of the patterns of functional skills in the Disadvantaged compared with the Normative group should enhance specific knowledge of the strengths and weaknesses of the Disadvantaged group. This, in turn, could indicate further directions in curriculum planning for compensatory education programs.

While the Screening Tests are very close to being ready for practical use by Head Start personnel, the Curriculum Guide is less directly translatable by the average classroom teacher. The aim of the year's curriculum development has been to write down the sequences of development in the three information processing modalities and the general sequences of teaching activities within these modalities. However, this material needs considerably more development and modification to be able to be used by the classroom teacher who needs lesson plans, unit guides, and the translation of the skill sequences into the form of traditional preschool activities. This will require a minimum of one or two years of effort to accomplish. In the meantime, the guidelines and representative activities in the Curriculum Guide will undoubtedly aid curriculum planners and master teachers in adding this dimension to the steadily growing core of interesting teaching approaches for the disadvantaged.

Meeting Street School has just been awarded a planning grant by the Bureau for the Education of the Handicapped in anticipation of becoming one of the twenty-five Exemplary Early Childhood Education Centers. The material in the present Curriculum Guide will furnish the skill basis in the three information processing modalities for curriculum to be developed in the future. The research co-directors will keep the Office of Economic Opportunity informed of the progress of this curriculum development and will be eager to see its selective use in Head Start classrooms.

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APPENDIX ONE

ITEM POOL ONE

MEETING STREET SCHOOL SCREENING TEST (Form Ed-4)

Name____________________________Date________School____________Examiner____________

Age________SE______________________

MOTOR PATTERNING

GAIT PATTERNS (5)

.....Hop at least 5 times on both right and left feet in stationary position (1)
.....Skip (2) or lame duck (1)
.....Dance (RR-LL-RR-LL): (2) imitates with demonstration only, (1) second trial with E counting steps.

CLAP HANDS (6)

.....(up-down) (1)
S.....front-front-back (no. in 3) (1 for correct second trial)
.....up-up-down-back (no. in 2)

HAND PATTERNS (6)

.....(up-down) (1)
S.....out-cross-out-in (1)
.....up-down-out-in (no. in 2 attempts)
.....slant up-down-in (no. in 2 attempts)

FOLLOW DIRECTIONS I (6)

.....Put this . . .above your head and then behind you.
.....Take 2 steps forward and 1 step backwards.*
.....Turn to your right.
.....Take 3 steps toward me and then turn and face away from me.*
.....Put this . . .between us and then nearer to you.
.....Turn right, take 2 steps backwards and then turn left.*

*½ for right direction, wrong number of steps.

TOUCH FINGERS (6)

.....(Can do separately)..............(1)
S.....Thumb to 2,3,4,5; (1) if takes over 7 secs. (2) if under 7 secs.
.....Second trial on above; (1) if under 7 secs.
.....Thumb to 2,4,3,5; (1) if over 7 secs. (2) if under 7 secs.

SUBTOTAL (out of 29)____________________

PERCEPTUAL-MOTOR

BLOCK TAPPING (6)

Example 1 2
.....1 3 3
.....5 4 2
.....1 5 3
.....5 1 4 3
.....3 5 2 4 1
.....3 2 4 3 1 4

MATCHING (5)

.....line 1, (1) for correct.
.....line 2, no. right minus no. wr
.....line 3, no. right minus no. wro

MEMORY (6)

.....Backwards N
.....circle, square
.....diamond, triangle
.....b
.....may
.....with them

COPY (8)

.....circle, square
.....diamond, triangle
.....may
(See Manual for Scoring Procedures)

FOLLOW DIRECTIONS II (5)

.....Draw a ball behind the car.
.....Draw a line from the bottom of your page to the car.*
.....Draw a line from the right hand side of your page to the car.*
.....Draw an X in the upper left hand corner of your paper.
.....Draw a ball in the bottom right hand corner of your paper put an X inside it, and draw a square around them.

*½ for right line drawn from wrong point.

SUBTOTAL (out of 30)________________

LANGUAGE

REPEAT WORDS (5½)

.....ah-man-ee
.....laudy-tu-dum
.....kaka-kada'kat
.....tum titty um tum tum
.....dia-do-ko-ki-nee-sis

.....quack duck quack
.....feminine
.....above and below
.....musicology
.....transcontinental
.....popocatepetal
Total divided by 2

REPEAT SENTENCE (5)

.....Please pass the meat and peas (6)
.....Joan and Jane had a chocolate sundae after the movie yesterday (11)
(17=5, 15 & 16 = 4, 12-14=3, 9-11=2, 6-8=1, 0-6=0)

COUNTING (7)

.....(how many blocks in the row of 5) (1)
S.....forwards: (1) to 10 in over 6 secs.
(2) to 10 in under 6 secs.
.....backwards: (1) from 5 but not 10,
(2) from 10 but not in 6 secs.
(3) from 10 in under 6 secs.
.....count to 10 by twos. (1).

TELL A STORY (5)

____
____
____
____
____

(o) irrelevant detail or nothing
(1) naming of 2 figures
(2) one figure in action
(3) two figures interacting
(4) three figures interacting together
(5) score of 4 plus imagination

SEQUENCING (6)

.....breakfast, lunch (give answer if fails)
.....morning, afternoon (give answer if fails)
.....yesterday, today
.....fall, winter
.....Sunday, Saturday, Friday
.....week, day, hour

SUBTOTAL (out of 28½)____________

SCORING

_____Motor Patterning .....

_____Perceptual Motor .....

_____Language .....

_____TOTAL MSSST SCORE (out of 87½) .....

RATING SCALE

|____|____|____|____|
Hyperactive Explosive — lethargic

|____|____|____|____|
Anxious — confident

|____|____|____|____|
Cooperative — resistant

|____|____|____|____|
On the ball — vague

|____|____|____|____|
Independent — depedent on examiner

|____|____|____|____|
Concentrates well — distractable

Comments:____________________________
____
____

APPENDIX TWO

ITEM POOL TWO

PHYSICIANS MSSST

VISUAL DISCRIMINATION (11)

Present card with 11 line drawings and ask child to tell what each looks like. Check correct replies listed below or write in alternates.

...1. chair.............................
...2. clock, watch......................
...3. animal............................
...4. house, oil can....................
...5. plane.............................
...6. stairs, steps.....................
...7. figure in motion..................
...8. long-tailed animal................
...9. bat, butterfly, bird..............
..10. pie, cake, clock..................
..11. grasping tool.....................
Score 1 for each correct response......

AUDITORY DISCRIMINATION (14)

Show the child the sets of pictures and tell him you will say one of these and he is to point to which one. The examiner says the words in a normal conversational voice loudness but with a piece of paper held about three inches in front of his mouth so the child cannot see the sound production.

1.	bear...........	mail..............
2.	shoe...........	picture...........
3.	shake..........	shoulder..........
4.	½ a ball.......	crown.............
5.	3 tops.........	ask...............
6.	feed...........	D's...............
7.	bag............	pen...............

Score 1 for each correct response......

GRAPHESTHESIA (7)

Ask child for his right arm and draw the following figures and numbers on underside of arm with a lollypop stick. The child is to point to the corresponding figure or number on the card. Then do the same on the left. Draw half way between wrist and elbow. Hold stick on arm for 1 sec. before drawing.

Rt.	O....	Lt.	O....
	X....		☐....
	☐....		4....
(open page out)	3....		9....
	6....		4....
	X....		8....
	40...		6X...

Score add total correct and divide by 2 ....

VISUAL TRACKING (9)

Starting with road number 3, ask child where the road ends. If he cannot do it by just looking, have him follow it with his finger only on #3 or #1 or #2, if necessary. Child fails if he back tracks with his eyes on any road.

1.......2.......
S 3.......4.......
5.......6.......
10.....11.....12.....

Score 1 point for correct by sight and ½ for use of the finger on #3, 2, or 1........

PUH-KUH-TUH (undetermined total score)

The examiner should ask the child to repeat the following:

puh........(0)
S puh-kuh.....(1)
puh-kuh-tuh.......(1)
puh-kuh-tuh, puh-kuh-tuh...(2 or 1)

In this section the examiner should score these items only if the child repeats it correctly on the first trial. However, the examiner should make sure the child can perform each step before continuing (up to a maximum of 3 tries on each) however he is scored 0 unless he got it on the first presentation. Discontinue test when child is unable to do two lines, even after 3 trials per line.

---

puh-kuh-tuh.......(# in 5 sec.)
puh-tuh-kuh.......(# in 5 sec.)
tuh-puh-kuh.......(# in 5 sec.) ....
Score for FINE PATTERNED MOVEMENT_____

TAPPING RHYTHMS (9)

The examiner should knock under table and the child is to repeat by tapping his knuckles on the table like examiner was knocking.

...1. SL/SL(to "Around the World") (1)
...2. L/SS(to "Oh Say Can You See")(1)
...3. LL/SS(to "Sweet Adeline") (1)
...4. LL/LL/ss(to "My country tis of thee") (2)
...5. L/SL/SSSSL(to "All around the mulberry bush") (2)
...6. L/SS/LLL (to "Oh say can you see") (2)

Score 1 for 1,2,3; score for 4,5,6, is 2 for all parts right, 1 for 1 wrong, and 0 for 2 parts wrong.......

COUNTING FINGERS (13)

Examiner says, "Now we are going to count fingers". Take child's left hand with palm facing child at face height. Start numbering from thumb by gently squeezing each finger 1,2,3,4,5; count # of trials up to 3 that it takes child to #5 fingers ....(score:correct on trial 1=2; 2=1;3=0).

Then behind screen with one hand:
(a)1....5....3....4....2....
(b)2 hands behind screen number from 1-10 with child then give reference points 1 & 10 on fingers:
7....3....8....4....6....9....
....

BILATERAL RHYTHMS (9)

Turn your chair and the child's facing each other so there is an unobstructed view between you and the child's feet can touch the floor(he may need a smaller chair). Then say to the child, "watch carefully and then do what I do". TO AVOID GIVING EXTRA CUES, THE EXAMINER SHOULD HAVE BOTH PALMS ON HIS KNEES WHEN NOT IN MOTION.

...1. both hands slap knees, both slap again (in equal beats)
...2. both, clap hands, clap hands
...3. left hand, right hand, right hand.
...4. right, left, left

Here caution child that you will use hands and feet.

...5. right, left foot, left foot
...6. left, right foot, right

Here caution the child to watch very carefully.

...7. left, left foot, clap hands, right foot
...8. left, right, right foot, left foot
...9. right, left, right foot, clap hands

Score 1 for each numbered section......
SCORE FOR CROSS MODALITY.........

STAND ON ONE FOOT (9)

Encourage child to keep standing on one foot while the examiner counts to 15 at one per second. Then do the other foot. Give another trial on each foot and score the median of the four trials.

Trials: 1.....2....3....4....Median....

REPETITIVE HAND & FOOT TAPPING (9)

Show child the following tapping movements and have him sustain them until told to stop.

1. Hands over and back:striking the table palms down, them palms up. Count the number done synchronously in 15 seconds.
2. Right hand and right foot(15").......
3. Left hand and right foot(15").......

Score........

CROSS-OVERS (9)

1. Slap back of ones other hand (i.e. right hand slaps back of left hand, left hand slaps back of right hand, etc., (15")..........
2. Right hand slap left toe, left hand slap right toe, etc. (15").........

Score............

SCORE FOR GROSS MOTOR (27)............
TOTAL SCORE FOR TEST (   )............

STANINE	1	2	3	4	5	6	7	8	9
Stand 1 foot	0-2	3-4	5-6	7-8	9-10	11-12	13	14	15
Hand-Foot taps	28	29-36	37-42	43-48	49-54	55-59	60-69	70-79	80+
Cross-Overs	10	11-14	15-16	17-18	19-20	21-23	24-25	26-30	31+

APPENDIX THREE

ITEM POOL THREE

MEETING STREET SCHOOL SCREENING TEST - 3

NAME: ______________________________ Sex: ______ Birth Date ________________

School: ________________ Grade: ________ Father's Occupation: ________________

Examiner: ______________________________ Test Date: ________________________

☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐

HAVE CHILD SIT AT THE TABLE

REPEAT PHRASES

Say the following phrases one at a time distinctly to child and ASK HIM TO SAY THEM JUST THE WAY YOU DID.

☐ 1. WIGWAM
☐ 2. ELEPHANT
☐ 3. SPAGHETTI
☐ 4. BOBBY'S BABY BOOK
☐ 5. MAGAZINE STORE
☐ 6. ANIMAL MAN
☐ 7. BEHIND AND AHEAD
☐ 8. RUN GRANNY RUN
☐ 9. SEA SHELLS
☐ 10. ALUMINUM LIMITED (out of 2 words)
☐ 11. FISHING POLES AND WISHING WELLS (out of 5 words)
☐ 12. THISTLES AND THORNY BUSHES (4)
☐ 13. DARING DANNY DID A DEADLY DEED (6)
☐ 14. BUFFALO BILL SHOT A BULL WITH A BELL ON (9)

SCORE: 0 or 1 on numbers 1-9 and the number of words correct in each of 10-14 (possible score in brackets).

PICK-UP STICKS

Materials: 14 sticks. The examiner drops the 14 in a clump (all facing the same way) and says, "I WANT YOU TO PICK UP THESE STICKS LIKE I DO." In each of the three trials the examiner picks up two for demonstration and lets the child pick up two. Be sure child uses his dominant hand. Then examiner says, "THAT WAS VERY GOOD, NOW PICK UP THE REST AS FAST AS YOU CAN--RACE MY CLOCK...READY...GO.

SCORE: is number of seconds on each trial, timed from moment child's hand touches the first stick until the ten remaining sticks (14 minus the four already picked up) are picked up according to instruction.

☐☐ 1. Picking up sticks one at a time and dropping them in the box at child's midline just beyond the sticks;
☐☐ 2. As above but holding accumulated sticks in same hand;
☐☐ 3. Picking up with thumb and baby finger and putting in the box as in #1.

TONGUE MOVEMENTS

1. Get child by demonstration to put his tongue as far over in one corner of his mouth as he can. Then have him do it in the other corner, then down toward his chin and finally up toward his nose. Child gets two trials at each of these positions.

L.
R.
up
Dn.

SCORE: 1 or 0 for each of four positions. To get a score for up and down, child must be able to curl tongue and have it appear above and below lip edge. Then encourage him to go from corner to corner and then say, "NOW KEEP DOING THIS AS FAST AS YOU CAN."

2. Trial 1: Time child from time he starts until he completes 8 side to side patterns;

3. Trial 2: Say, "That was good but try to do it even faster." Time him for another 8 patterns. Spoiled patterns are not counted and child must go eight good patterns before physician stops him. Do not stop watch when spoiled patterns occur; merely omit them from the count of 8.

Physician and Child go to Wall Chart

FIND FORMS (VISUAL)

Material: wall chart, and card with forms on two sides.

1. Place card 1a at top center of wall chart above figures. The physician puts his finger on the first form (window) and then on the same form below, indicating to child what he is doing. Then he does the same for the wheel. Then ask the child to TOUCH THE ONE AT THE TOP AND THE ONE ON THE CHART AS QUICKLY AS YOU CAN.

SCORE: number of seconds to touch the three forms in the two places. If child matches any incorrectly, have him redo at the end and keep the time running, saying "NOW THIS ONE AGAIN.**

2. Card 1b: turn card over and say, NOW DO ALL OF THESE AS QUICKLY AS YOU CAN ... START HERE (pointing to figure)**

SCORE: number of seconds (as above), for child to do correctly.

3. Card 1b repeat: ask the child to DO IT AGAIN AND SEE IF YOU CAN GO EVEN FASTER.**

SCORE: As above.

**DISCONTINUE ANY TRIAL AFTER 45".

MATCH FORMS

Materials: wall chart and sheet with alternate forms. Point to the form on the wall chart saying, "LOOK AT THIS PICTURE CAREFULLY...I'M GOING TO ASK YOU TO FIND IT." After the child has looked at the form on the chart, cover the form with the sheet of alternate forms and ask him to point to the correct one. If he is incorrect, place sheet of alternate forms just to the right of the form on the wall chart and ask the child to find (match) it.

SCORE: correct from memory (2), correct by matching (1), (0) if unable.

1. Pie
2. Chair
3. Animal
4. Long tailed animal
5. Airplane
6. Clock
7. Figure

FINGER PURSUIT

Materials: Percolator cap and wall chart. Rotate cap in circle within wall chart at rate of one revolution in two seconds. Examiner should practice this so he can manage it smoothly and easily. Examiner demonstrates as he says, "TOUCH YOUR NOSE AND CATCH THIS AND THEN TOUCH YOUR NOSE AGAIN AND CATCH IT AGAIN AS FAST AS YOU CAN."

As soon as child is doing it quickly from nose to cap and back (as you rotate cap), tell him you will time him to see how fast he he can do it. Start retating cap and then tell child to GO and start the watch when you say go.

☐ Trial 1: When child is made 8 insertions with his finger record the time elapsed since he started.

☐ Trial 2: time him for another 8 insertions, and encourage him by saying, "LET'S SEE IF YOU CAN GO EVEN FASTER THIS TIME."

WIND SPOOL

Material: spool with string attached. Examiner winds spool up saying, "I WANT YOU TO WIND THIS SPOOL AS FAST AS YOU CAN." Then he places the spool on the table with string dangling away from child, placing spool at midline.

☐ Trial 1: Say go and time child from moment his hand touches the spool until he has it wound up (stop him after 45 seconds or if he winds with two hands on the spool--in this case demonstrate again for child and start him over);

☐ Trial 2: give another trial as above and score number of seconds.

INKBLOTS

Show the inkblots and encourage child to tell what it looks most like. Record answers below if different from standard in parenthesis. Return to blots not responded to at the end.

☐ 1. House ____________________
☐ 2. Flags ____________________
☐ 3. Bone or Barbells ____________
☐ 4. Lollipops or Balloons _________
☐ 5. Table with some round object on it ____________________
☐ 6. Face (eyes, nose, mouth, score 0) ____________________
☐ 7. Two bugs of some description and a flower or other garden specie ______________
☐ 8. Bird, tent or tree with clouds on top ______________
☐ 9. Two peoples heads ____________
10. Two people, monkeys or cartoon figures ______________
☐ 11. Two animals sticking heads out of basket ______________
☐ 12. Butterfly ______________
13. Two worms or like insect with some reasonable object between them ______________
☐ 14. Two human figures with the part on the hands explained _______ ______________
☐ 15. Clown or man or dog dressed up ______________
☐ 16. Two animal figures in action in relationship to one another __ ______________
☐ 17. Two rabbits)heads) __________ ______________
☐ 18. Mountain or Hill __________

TRACED FIGURES

Show card with six shapes, and say "I want you to draw each one with your finger (like this, examiner demonstrates) and tell me what it is."

☐☐ Score: trace-name (no. out of 6)

Tell child you are going to draw some of these on his hand and then he has to pick up his pencil and draw each one. Be sure to draw on his dominant (writing) hand while child has his eyes closed. His hand should also be shielded with your other hand. (Do not leave card in child's view). Draw with lollipop stick.

☐ _____Vertical line
☐ _____Square
☐ _____X
☐ _____Triangle
☐ _____Horizontal Line
☐ _____Circle

Then turn card over to show

☐☐☐ numbers and letters. As above, ask child to trace and name the top line (5,6,2) and then draw the 6 on his hand as above. Score: trace-name-copy (out of three, three and one).

☐☐☐ Do the same for row two (8,7,3,) and copy the 3.

☐☐☐ Do same for letters in row three, drawing the C (Score is now out of four, four and one).

☐☐☐ Do the same for the letters in row four, drawing the W.

APPENDIX FOUR

PHYSICIAN-EDUCATOR SCREENING TESTS

PHYSICIAN AND EDUCATOR SCREENING TESTS
(FIELD TESTING EDITION)[1]

PHYSICIAN SECTION

AUDITORY DISCRIMINATION

(Materials: 4 cards with drawings) Examiner places set of cards facing child and says, "I want you to look at all of these pictures... (pause)... Now I'm going to say one and I want you to point to that picture."

1a. SHAKE (1)
b. SHOULDER (1)
2a. HALF A BALL (1)
b. CROWN (1)
3a. THREE TOPS (1)
b. ASK (1)
4a. FEED (1)
b. FOUR D'S (1)
TOTAL SCORE: (8)

Examiner says each word in conversational loudness, conceal mouth from child's view by holding hand or paper 3' from mouth. Score: 1 for each correct.

TAPPING RHYTHMS

Say, "I'm going to knock on the table in a very special way. I want you to listen carefully because I'm going to ask you to knock the very same way I do... Try this one." (eg S S) Examiner can repeat example up to three times until child can do it. Examiner should then knock the following behind a screen in a rhythmic fashion as follows: L (long) at 1 per second and S (short) 2 per second. Give two demonstrated trials if necessary on each pattern; discontinue when child fails two rhythms.
Score: 2 for correct on first trial; 1 for correct on second trial.

1. L/S S (count 1 2/3 4 evenly to yourself, the L takes 1 and 2, the S's follow on 3 and 4 respectively).
2. SS/L/SS/L (Jingle Bells, Jingle Bells)
3. SS/LLL/L (Oh Say Can You See)
4. LS/LS/SSS/L (All Around the Mulberry Bush)

TOTAL SCORE: (8)

PUH-KUH-TUH

(Materials: stopwatch)
Say, "Now I'm going to say some words and I want you to say them just like I do."
SECTION A: The examiner should ask child to repeat the following words. Child is given three trials to correctly repeat each step. However, only his first response to each is scored. Discontinue test at any step where child cannot repeat after three trials.

PUH-KUH (1)
PUH-KUH-TUH (1)
PUH-KUH-TUH, PUH-KUH-TUH (1)

Score: 1 for correct on first trial on each of the four above. . possible total of 3.

---

[1] Developed under Grant B 89-4596, Office of Economic Opportunity. Field testing edition for test development purposes only. See research report, Development of Psychoneurologically-Oriented Screening Tests and Curriculum for the Disadvantaged Pre-School Child, 1969.

SECTION B: "Now I want you to say puh-kuh-tuh, puh-kuh-tuh, puh-kuh-tuh quickly until I tell you to stop." Do same for puh-tuh-kuh... introducing by, "This one will be a little bit different." Give child a chance to try new sequence once before 5" trial.

Score: 1 for each sequence (i. e. puh-kuh-tuh) in 5". A score of 3 to 7 is usual for each of the sequences.

☐ PUH KUH TUH SEQUENCE (# in 5 secs.)

☐ PUH TUH KUH SEQUENCE (# in 5 secs.)

☐ TOTAL SCORE:

WIND SPOOL

(Materials: spool with string, stopwatch)

Examiner winds spool up while saying, "Watch very carefully how I'm winding this spool because I'm going to ask you to do it just the way I am doing it."

Place unwound spool on table at child's midline with string leading away from child.

☐ TRIAL 1: "When I say go, pick up the spool and wind it as quickly as you can...GO."

Stop any child after 45" and score 45 for the trial.

TOUCH FINGERS

☐ HANDS TOGETHER: (trial 1): Say, "I'm going to touch my fingers like this...." (demonstrate)... "you watch carefully so you can do it... touch each finger to the thumb, both hands at the same time."

Score: 2 for correct in under 7", 1 for correct in 7 or over.

☐ HANDS TOGETHER (trial 2): For those scoring 0 or 1 on Hands Together (trial 1), demonstrate again. For all others say, "Very Good...now do it again." Score 2 or 1 as trial 1.

☐ HANDS SEPARATE: Credit 1 point each for right and left hands. If child gets 2 or better on either trial of Hands Together, go on to next level, and credit 2 points for Hands Separate. If child does not get 2 or better, administer Hands Separate to score 1 point for each hand correct on 1 trial and discontinue test.

☐ THUMB TO 2, 4, 3, 5: (Do only if child got one Hands Together trial correct, 2 or 3 points). Say, "Now we are going to do it a different way.... watch carefully so you'll know how."

Score: 2 for correct in under 7", 1 for correct in 7 or over.

☐ TOTAL SCORE: (8)

FIND FORMS

(Materials: wall chart at child's eye level, Card A, stopwatch).

☐ CARD A (side 1): Place A1 at top center of wall chart above figures. Say, "Put your finger on the "house" (examiner gestures)..now we're going to find one just like it down here." (take child's hand and put his finger on "house" on wall chart). "Now we're going to do this one the same way." (put child's finger on next one on card A1 and encourage him to find it on wall chart by starting hand motion but letting the child do the finding. Do same for last one on card and wall chart). Then putting his finger on "house" again, say, "When I say go, I want you to do them all again as fast as you can... ready...go."

Score: time between saying "go"

and touching last form on wall chart. If child matches any incorrectly, have him redo at end, and keep time running saying, "Now this one again," etc.
CARD A (side 2): Say, "Now, when I say go, I want you to do all of these the same way as fast as you can. . . ready. . . go."
Score: Time as above
TOTAL SCORE:

TRACED FIGURES

Show card with forms and say, "I'm going to draw one of these forms on your hand and then you draw it on this paper with your pencil." After child has had a good look at the forms examiner covers the card with the folded sheet and draws on child's dominant (writing) hand with stick, shielding his hand with the examiners so he cannot see what is drawn, then indicate he is to draw it. Before each tracing show card C1 for a few seconds.
VERTICAL LINE (2)
SQUARE (2)
Then turn card over to C2 and say, "Now I'm going to draw one of these three numbers." Point to 8, 3, 4; draw 3 on child's hand following method above. Then say, "Now I'm going to draw one of these three letters." Point to C, W S; and draw S.
NUMBER 3 (2)
LETTER S (2)
TOTAL SCORE: (8)

CROSS OVERS

(materials: stopwatch)
HAND CLAPS: Say, "Watch what I'm doing and do it along with me." The examiner slap back of one hand with palm of other and vice versa. Do it slowly at the rate of one per second until child is performing it too. Then stop him and say, "Now I want you to do it as quickly as you can until I tell you to stop."
Score: number of two slap patterns (rt. hand slap, lt. hand slap) in 30".

COMMON SECTION

REPEAT PHRASES

Say, "I'm going to say some words and I want you to say them after me." Child should be encouraged to speak distinctly.
ah́-măn-ee (1)
laudy-tú-dŭm (1)
above and below (1)
behind and ahead (1)
kăkắ-kădắ'kat (1)
tum'titty um'tum tum' (1)
quack duck quack (1)
transcontinental
Score: phrases; 1 point for correct pronunciation and word order.
TOTAL PHRASES (8)

REPEAT SENTENCES

Say, "These are a little longer, listen carefully."

1. PLEASE PASS THE MEAT AND PEAS (6)
2. IN THE FIRST INNING, TOM HIT THE BALL (8)
3. JOAN AND JANE HAD A CHOCOLATE SUNDAE AFTER THE MOVIE YESTERDAY (11)

Score: Sentences; 1 point for each word in correct order. Number possible in each sentence is in ( ).
TOTAL SENTENCES

MATCH FORMS

(Materials: wall chart and 7 cards) Examiner points to pie on wall chart and says, "I want you to look at this very carefully because I'm going to hide it and ask you to find it on this card I'm holding." Have him look carefully at form on wall chart for five seconds and then put card with three drawings of pie over picture on wall chart and say, "Which one of these is just like it." If child is incorrect or takes longer than fifteen seconds, pull card down so that pie on wall chart is above the 5x8 card and say, "Which one do you think it is now." Discontinue when child gets 0 score on 3 sections.
Score: 2 for correct from memory; 1 for correct on matching, 0 for incorrect on both trials.

PIE (example)
CHAIR (2 or 1)
LONG TAILED ANIMAL (2 or 1)
CLOCK (2 or 1)
FIGURE (2 or 1)
TOTAL SCORE (8)

CLAP HANDS

SLAP-CLAP-CLAP: Say, "I'm going to clap my hands in a special way... wait until I say go and then do it." Sequence is demonstrated twice and child makes 2 attempts. Sequence is slap thigh fronts once and clap hands twice at waist height, at even rate of 1 per second with a pause before each repetition.
Score: Number correct in 2 attempts.

FRONT-FRONT-BACK: "When I say go, you do this one." Examiner demonstrates 3 times and gives child 3 attempts. If he fails all 3, demonstrate again. Sequence is clap twice in front and once in back at waist height.
Score: 3, 2 or 1 following first demonstration, 1 for 1 + 2nd demonstration.

DIAGONAL CLAPS: As above, demonstrate twice and give child 2 attempts. Sequence is clap once each at left shoulder, right hip, right shoulder, left hip.
Score: Number out of 2 in 2 attempts.

TOTAL SCORE (7)

GAIT PATTERNS

HOP: Say, "Show me how you can hop in one place... keep hopping until I tell you to stop." Encourage five hops on each foot... a false start is not counted.
Score: 1 for five times on each foot-total possible is 2.

SKIP: Say, "Show me how you skip." Examiner can demonstrate and child may have two trials.
Score: 2 for skip, 1 for lame duck.

DANCE: Say, "Now we're going to do an Indian Dance... you watch me, then its your turn." Examiner hops twice on one foot, then twice on the other, etc. If child can't do demonstrate a second time counting one-two, one-two as demonstrate.
Score: 2 for correct after first demonstration, 1 for correct after second.

TOTAL SCORE: (6)

EDUCATOR SECTION

COUNTING

FORWARDS 1-10: Say, "I want you to start at 1 and count to 10 quickly." If child slurs, ask him to go more slowly; if he goes too slowly, ask him to count again more quickly and score this second attempt.

Score: 3 for 1-10 in under 7", 2 for 1-10 in 7 or more seconds, 1 for 1-5

BACKWARDS 10-1: Say, "Now I want you to start at 10 and count down to 1." Examiner can help child to extent of asking what comes before 10. If child still can't do, examiner counts 10, 9, 8, 7 and ask child to finish.

Score: 3 for 10-1 in under 7", 2 for 10-1 in 7 or more seconds, 1 for 5-1.

COUNT TO 10 BY 2's: Say, "Count to ten by two's." If child can't do start him with "2, 4 now you finish it."

Score: 2 for correct without help, 1 for correct following examiner saying 2, 4.

TOTAL SCORE: (8)

SEQUENCING

"This time I want you to tell me what comes next...breakfast (pause) lunch (pause) and...", indicating by gesture or tone of voice that you want him to tell you what comes next. If a child has difficulty understanding, the examiner may repeat the words "Breakfast, lunch" or may say, "First we have breakfast, then lunch, and...you tell me what comes next." The child may be given two or three attempts in this fashion. If he does not then succeed, tell him the answer and go on to the next sequence (morning, afternoon....), again giving the answer if he fails. The examiner then proceeds with the other sequences one by one, without supplying any answers.

Breakfast, lunch (give answer if fails)
morning, afternoon (give answer if fails)
yesterday, today
fall, winter
Sunday, Saturday, Friday
week, day, hour
TOTAL SCORE: (6)

VISUAL INTEGRATION

(Materials: wall chart)
Examiner points to form at top left of wall chart (house). "What does this picture look most like to you?" Examiner may encourage answer by saying "Guess what it is...what does it remind you of...it must look like something...etc." Do other pictures same way, going across wall chart.

HOUSE (1)
CHAIR (1)
CLOCK, WATCH (1)
SUN, COMPASS POINTS (1)
FIGURE IN MOTION (1)
PIE, CAKE, CLOCK (1)
ANIMAL (1)
Score: 1 for each correct.
TOTAL SCORE: (7)

FOLLOW DIRECTIONS II

(materials: blank 8 1/2 x 11" sheet and pencil). Examiner draws a 1 1/2 x 1 1/2" square (box) in the middle of the blank page and says,

1. DRAW AN X INSIDE THE BOX
2. DRAW A BALL ABOVE THE BOX
3. DRAW A LINE FROM THE BOTTOM OF THE PAGE TO THE BOX
4. DRAW A LINE FROM THE RIGHT HAND SIDE OF THE PAGE TO THE BOX.
5. DRAW AN X IN THE UPPER LEFT HAND CORNER OF THE PAGE.
6. DRAW A SMALLER X BETWEEN THIS ONE (point to other x) AND THE BOX AND PUT A LINE UNDER IT.
7. TURN YOUR PAGE OVER, DRAW AN X, PUT A CIRCLE BESIDE THE X AND THEN DRAW A SQUARE AROUND BOTH.

Score: 1 for each correct.
TOTAL SCORE: (7)

COPY

(Materials: Cards D, E and G, blank space at the top of page C-2 of the record sheet, pencil for the child.)

CIRCLE-SQUARE: Show Card D to the child and say, "Take your pencil and copy this (pointing to the circle-square) as neatly as you can, here." Card D is left showing while the child makes his drawing. Some impulsive children need cautioning to work as neatly as possible.

DIAMOND-TRIANGLE: Show the child Card E and say, "Now copy this one."

MAY: Show Card G and say, "Write the word "may".

Scoring: Add the score for Circle-Square (3), Diamond-Triangle (3) and May (2) for a possible total of 8.
TOTAL SCORE: (8)

FOLLOW DIRECTIONS 1

With child standing, say, "All right, stand straight and listen and do what I tell you."

1. TAKE TWO STEPS FORWARD AND ONE STEP BACKWARDS.
2. TURN TO YOUR RIGHT.
3. TAKE THREE STEPS TOWARD ME AND THEN TURN AND FACE AWAY FROM ME.
4. TOUCH YOUR RIGHT EAR WITH YOUR LEFT HAND.
5. TURN RIGHT, TAKE TWO STEPS BACKWARDS AND THEN TURN LEFT.
6. PUT THIS PENCIL (hand to child) ABOVE YOUR HEAD AND THEN BEHIND YOU.
7. PUT THE PENCIL BETWEEN US AND THEN NEARER TO YOU.

Score: 1 for each done exactly -- right direction and number of steps.
TOTAL SCORE (7)